

## ABSTRACT

Title of Thesis:                   **PROSTHETIC ARCHITECTURE: ENABLING  
CONNECTION, MOVEMENT, AND  
EMPOWERMENT**

Rachel Flinn, Master of Architecture, 2016

Thesis Directed By:           Professor, Garth Rockcastle, Architecture,  
Planning and Preservation

This thesis explores the relationship between body and architecture through a metaphorical and literal analysis of prosthetic devices. The thesis questions how the relationship between prosthetics and architecture can inform the design of a building that enables connection, movement and empowerment for its occupants. Driving questions of investigation include: How can a building enable growth, healing and wellbeing? , How can a building embody and reflect human growth and transformation? , and, How can a building enable equivalence between its users? The program of an inpatient prosthetic rehabilitation facility allows for the exploration of these questions and a study for how we can create spaces that influence rehabilitation and growth. Through body and prosthetics analysis the thesis explores what spaces are best for one to grow and develop in and study how concepts, such as connection, movement and empowerment can enable one and enhance one's quality of life.

NARRATIVE OF GROWTH THROUGH A BUILDING: BODY  
REHABILITATION

by

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University of Maryland, College Park, in partial fulfillment  
of the requirements for the degree of  
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## Preface

*“At the very beginning of our individual lives we measure and order the world out from our own bodies: the world opens up in front of us and closes behind...at its beginnings all architecture derived from this body-centered sense of space and place.” – Kent C. Bloomer and Charles W. Moore<sup>1</sup>*

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<sup>1</sup> Kent C. Bloomer and Charles Willard Moore, *Body, Memory, and Architecture*, (New Haven: Yale University Press, 1977).

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## List of Abbreviations

ADL – Activity of Daily Living

WRAMC – Walter Reed Army Medical Center

LRA – Local Redevelopment Authority

DOS – Department of State

IBS – Integrated Building System

HIPPA – Health Insurance Portability and Accountability Act

## Chapter 1: Background

### *Influence of Architectural Form*

*“We shape our buildings; thereafter they shape us.” – Winston Churchill*

This thesis explores how architectural form can influence human use and experience. Modern times and technology has caused a disconnection between body and architecture which in turn affects our physical and emotional response to the built environment. As technology boomed, human comfort was pushed aside in areas such as healthcare design, and the architecture became less humane. This thesis undertakes this issue of disconnect and studies how a building can respond to and foster human use and wellbeing. The thesis will analyze topics including connection of spaces, materials, people and activities; movement of body and flows; and empowerment of occupants both physically and mentally through the program of a prosthetics rehabilitation center.

### *Architectural Social Economic Considerations*

In most hospital and health care centers today there is a divide between the patient and built form creating uncomfortable, sterile spaces. In the beginning, hospitals were not places where people went to heal, but rather places where they

went after the possibility of recovery had passed. As time went on, hospitals grew to be the treatment and technological focused centers that they are today. As medical knowledge increased and breakthroughs in treatments grew, hygiene, cleanliness and new technology became key factors in design. While sterility is obviously good in terms of hygiene, as hospitals became cleaner, they became “colder, noisier, and less comforting,” giving ‘sterile’ a negative term when describing a spatial environment.<sup>2</sup> This thesis works to explore how design can balance technology and sterility with patient needs and comfort through enabling ease of connection and movement through the built environment.

#### Physical, Environmental and Psychosocial Patient Needs

Prosthetic users require physical, environmental and psychosocial rehabilitation. Patients go through both physical and mental challenges such as physical pain, new interactions with their environment, emotional frustrations and success, and realization of a new body image. This thesis works to create spaces that provide for these needs and ease these challenges. It aims to not only rehabilitate, but enhance the quality of life for the patients.

#### Evidence-based Design

Since the early 1980’s studies have been done to analyze how the design of a space can influence the healing process in patients through the creation of comfortable environments. In 1984, Richard Ulrich conducted a study showing that windows with

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<sup>2</sup> Esther M. Sternberg, *Healing Spaces: the Science of Place and Well-being*, (Cambridge, Mass.: Belknap Press of Harvard University Press, 2009).

views of nature in patient rooms speed up the healing process. This analysis lead to a field called evidence-based design which attracted media attention in 2004.<sup>3</sup>

Evidence-based design used physiological and health-outcome measures, such as length of stay, patient stress, mood and satisfaction indices, to evaluate the health benefits of architectural features in hospitals and health care centers.<sup>4</sup> The outcomes of these studies fall into three main categories: patient safety, environmental stressors, and ecological health. Within these categories, factors such as reduced injuries from falls, reduced medical errors, reduced noise, visitor's areas and green spaces all contributed to success. This thesis will factor in evidence-based design studies when considering design options to create comforting spaces and inspire healing for an inpatient prosthetic physical rehabilitation center.

### *Project Scope*

The project scope will focus on the building and its responsiveness to its users. The thesis will explore how to create comforting spaces, promote healing, and inspire patients through three scopes: connection, movement and empowerment. To enable equivalence between its users, the design works to provide ease of connection between people, places and activities within the building. Prosthetic connection analysis informs a structural and parti design that works to create an inspiring environment for its users. To allow a stronger engagement between the building and users, the thesis emphasizes the importance of movement and flow. At a larger scale, accessibility and circulation are very important to the prosthetic user. At a smaller scale, the spaces of the building aim to reflect the range of movement of the human

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<sup>3</sup> Sternberg, *Healing Spaces: The Science of Place and Well-being*.

<sup>4</sup> Sternberg, *Healing Spaces: The Science of Place and Well-being*.

body. Repetitive design elements create familiarity and comfort for the occupant. To inspire its users and enable empowerment, the building works to connect with its surrounding natural environment as well as engage liberating architectural details. The tectonics of the building can help to reflect human form and movement. Familiarity is important to comfort and the building should respond dynamically to the changing physical and emotional state of its users. As this thesis works to put the patient as number one in its design, diversity and responsiveness of its structure is important.

### Site Definition and Scale

This project sits on the former Walter Reed Army Medical Center site. The site has been abandoned since the hospital moved to Bethesda in 2011, but is currently being redesigned to incorporate mixed-use, residential, educational facilities, institutional buildings, and public green spaces. One of the main goals of the site redevelopment project is to connect the site with the surrounding community and engage the commercial corridor of Georgia Ave.

The site was chosen for this project because it provides multiple amenities and community engagement. The location allows for patients to leave the hospital post-surgery and relocate themselves in an inpatient facility within the community making the transition from hospital to home easier. The close connection to Rock Creek Park allows for a tranquil and empowering foreground for the building.



## Chapter 2: Theory

### Body and Architecture

*“At its beginnings all architecture is derived from this body-centered sense of space and place.” – Kent C. Bloomer and Charles W. Moore<sup>5</sup>*

#### History

In Vitruvian and Renaissance times, the body had a direct impact on architecture. The body was projected onto the building as an idea of ‘architectural anthropomorphism,’ or the ascription of human characters and attributes to buildings and edifices. Architectural theory during this time called for the building to act to confirm and establish the body in the world.<sup>6</sup> In the modernist movement, there was a progressive distancing of the body from the building. Anthony Vidler states in “The Building in Pain: The Body and Architecture” that, “Architecture incorporating reference to the human body was abandoned with the collapse of the classical tradition and the birth of a technologically dependent architecture.”

This thesis explores the idea of reincorporating reference to the human body in design and argues that this can enhance user experience and promote wellbeing,

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<sup>5</sup> Bloomer and Moore, *Body, Memory, and Architecture*.

<sup>6</sup> Anthony Vidler, “The Building in Pain: The Body and Architecture in Post-Modern Culture.” *AA Files*, no. 19 (Spring 1990): 3-10, accessed October, 07, 2015, Architectural Association School of Architecture.

but questions what this relationship is when the user is not able-bodied. The user of the building is the number one consideration and the building should be responsive to this. The form of the building should have a strong dialog with the function within. To explore how a building can respond to human form and function and enable connection, movement and empowerment in its users, this thesis begins with an analysis of a prosthesis and architectural relationship.

### *Prosthetics and Architecture*

*“Prosthesis: a device, either external or implanted, that substitutes for or supplements a missing or defective part of the body”<sup>7</sup>*

#### Prosthesis

Prosthesis derives from mid-16<sup>th</sup> century via Late Latin from Greek, from prostithenai, from pros ‘in addition’ + tithenai ‘to place’.<sup>8</sup> Prosthesis is often thought of in two different contexts: (1) those that rehabilitate and (2) those that enhance. This language leads to a fascinating connection with architectural design of which this thesis began to explore. Creating environments for enabling occupants can be a rehabilitative and/or enhancing. How can one *rehabilitate* the occupant’s experience or allow for *habitation* of space? How can one *enhance* the user’s experience and quality of life? The thesis explores this language through a prosthetic, architectural relationship.

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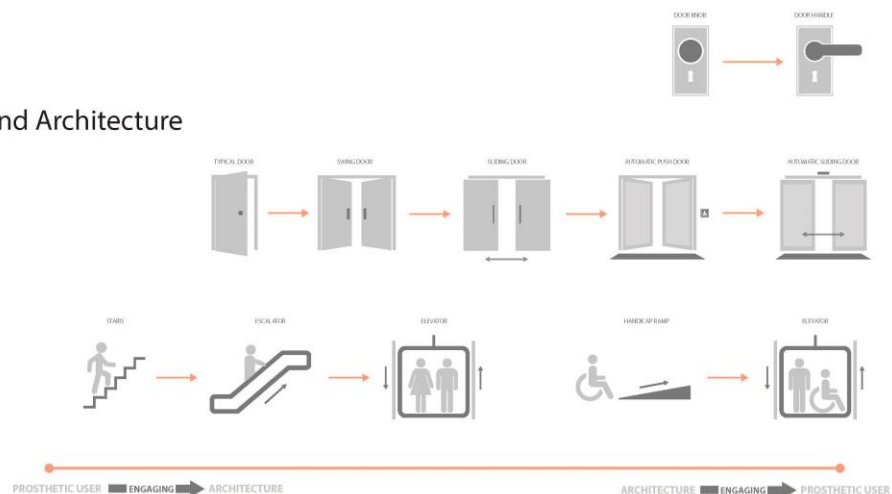
<sup>7</sup> “Prosthesis,” Dictionary.com Unabridged, last modified 2002, accessed March 2016, <http://www.dictionary.com/browse/prosthesis>.

<sup>8</sup> “Prosthesis,” Collins English Dictionary-Complete & Unabridged 10<sup>th</sup> Edition, last modified 2002, accessed March 2016, <http://www.dictionary.com/browse/prosthesis>.

## Architectural Relationship

Architecture already has “prosthetic” devices that allow one to reach out and interact with the built environment. There are subdual ways in which the building is reaching out to its user and allowing ease of access, use and occupation. These are objects that one takes for granted every day, such as the door knob, door, and stairs. These prosthetic devices are constantly evolving to allow greater access for a variety of occupants, enabling equivalence between its users, such as a door knob becoming a door handle, a typical door becoming a sliding or automatic door, and stairs becoming escalators or elevators. Rather than a user engaging architecture, architecture has begun engaging the user. This understanding creates a very dynamic relationship between architecture and body in which each is responsive to the other through means of “prosthetics” that enable one to access and engage a building with more ease and fluidity.

### Prosthesis and Architecture



**Figure 1 - Architectural Prosthetic Devices – Source: Image by Author**

## Prosthesis

*“Weight, pressure, and resistance are part of our habitual body experience, and our unconscious mimetic instinct impels us to identify ourselves with apparent weight, pressure, and resistance in the forms we see.” – Geoffrey Scott<sup>9</sup>*

### Role of a Prosthetic

The role of a prosthetic is to rehabilitate and enhance through means such as function, comfort, and appearance. Prosthetics can either be corporeal objects or life-enhancing tools. They mimic our muscles and joints and replicate them in a way that rehabilitates our bodies to preform previous activities. In some cases, they can even enhance our performance past our previous abilities.

The most important factors for prosthetic users are heat, weight, comfort and appearance. Researchers and manufactures of prosthetics strive to provide for these needs and enhance the users’ quality of life through a wide variety of prosthetic types and new technologies.

### Prosthetic Statistics

There are approximately 2 million people living with limb loss in the United States<sup>10</sup> and close to 185,000 amputations occurring each year.<sup>11</sup> Often times

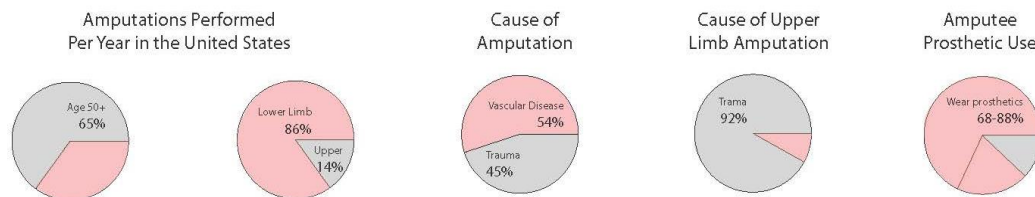
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<sup>9</sup> Bloomer and Moore, Kent C., *Body, Memory, and Architecture*.

<sup>10</sup> K. Ziegler-Graham, EJ. MacKenzie, PL. Ephraim, TG. Trivison, R. Brookmeyer, “Estimating the Prevalence of Limb Loss in the United States: 2005-2050,” *Archives of Physical Medicine and Rehabilitation* (2008) ; 89(3):422-9, accessed February 2016, [www.sciencedirect.com/science/article/pii](http://www.sciencedirect.com/science/article/pii).

<sup>11</sup> M. Owings, LJ. Kozak, “National Center for Health S. Ambulatory and Inpatient Procedures in the United States, 1996.” Hyattsville, Md.: *U.S. Dept. of Health and Human Services, Center for Control*

amputees are thought of as those who have survived traumatic experiences, or soldiers and veterans coming back from war. However, over half of the amputations in the United States each year are caused by vascular disease.<sup>12</sup> There are also thousands of children who receive amputations each year due to accidents and thousands more who require prosthetics from birth defects. The thesis takes on the challenge of providing a building for a wide variety of people in need of prosthetic fitting and rehabilitation.



**Figure 2 - Prosthetic Statistics** – Source: Image by Author

### Upper Limb Amputations and Prosthetics

There are multiple levels of upper limb amputation: forequarter, shoulder disarticulation, trans-humeral, elbow disarticulation, trans-radial, wrist disarticulation, full hand, partial had, finger and partial finger. The most common upper limb amputation is trans-radial.<sup>13</sup> Upper limb prosthetic users are either mono-lateral amputees in which the sound limb becomes dominant and the prosthetic works mainly as an auxiliary device, or bilateral amputees in which the prostheses are

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and Prevention, National Center for Health Statistics; 1998, accessed February 2016, [http://www.cdc.gov/nchs/data/series/sr\\_13/sr13\\_139.pdf](http://www.cdc.gov/nchs/data/series/sr_13/sr13_139.pdf).

<sup>12</sup> “Amputations and Limb Deficiency,” Division of Biology and Medicine, Brown University, accessed February 2016, [http://biomed.brown.edu/Courses/BI108/BI108\\_2003\\_Groups/Athletic\\_Prosthetics/Bkgd\\_text.htm#Amputation](http://biomed.brown.edu/Courses/BI108/BI108_2003_Groups/Athletic_Prosthetics/Bkgd_text.htm#Amputation).

<sup>13</sup> Division of Biology and Medicine, Brown University, “Amputations and Limb Deficiency.”

strictly necessary to preform every day activities.<sup>14</sup> This leads to a variety of prosthetic devices for upper limb amputees including passive, or cosmetic, prosthesis, body-powered prosthesis, and myoelectric prosthesis which are connected to the nervous system and allow the amputee to directly activate the prosthetic by means of input commands.

#### Lower Limb Amputations and Prosthetics

The most common lower limb amputations include trans-femoral and trans-tibial. Trans-femoral prosthetics replace a leg missing above the knee. In this case, patients have a difficult time regaining movement as it takes 65% more energy to walk.<sup>15</sup> Because of this, the type of prosthetic implemented is important in regaining a proper gait cycle. Trans-tibial prosthetics replace a leg missing below the knee. In this instance, patients are more easily able to regain normal movement. Some important considerations in the mechanical properties of prosthetics for these amputations are stiffness, range of motion and shock absorption.

#### New Technologies

There is a wide range of new technologies for prosthetic devices that enable better function and usage for the patient. The main goals for improving prosthetics are maximizing comfort, reducing weight, and improving thermal properties. Overall,

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<sup>14</sup> Marco Tronsossi and Vincenzo Parenti-Castelli, *Synthesis of Prosthesis Architectures and Design of Prosthetic Devices for Upper Limb Amputees*. (INTECH Open Access Publisher, 2007), accessed February 2016, <http://cdn.intechweb.org/pdfs/577.pdf>.

<sup>15</sup> “Transfemoral Prostheses for the Competitive Athlete,” Division of Biology and Medicine, Brown University, accessed February 2016, [http://biomed.brown.edu/Courses/BI108/BI108\\_2003\\_Groups/Athletic\\_Prosthetics/AK2.htm](http://biomed.brown.edu/Courses/BI108/BI108_2003_Groups/Athletic_Prosthetics/AK2.htm).

decreasing weight is the number one priority of prosthetic users.<sup>16</sup> In addition, design for anthropomorphism and sensation are desired.

As stated, prosthetic devices fall into three main categories: passive, body-powered, and myoelectric each of which should enhance a person's function and/or appearance. Some new technologies to increase this performance include energy storing feet, electronic control hydraulic knees, ankle rotators, shock absorbers and touch sensation. This wide range of technology and functional abilities in prosthetics can greatly inform architectural design.

#### Adaptation to Amputation and Prosthetic Use

Patients experience physical, financial, environmental, and psychosocial challenges. Physically, post-operative pain creates a major challenge to overcome. This includes residual stump pain, phantom pain, and mechanical pains from the prosthetics all of which need to be eased during the rehabilitative process.<sup>17</sup> Environmentally, patients have to readapt to their surroundings. This includes, learning how to negotiate public transportation and engaging with everyday objects.

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Psychosocially, patients have a variety of challenges. There are emotional consequences such as body image, identity and depression of which patients need comforting environments and social support to cope with. Both personal goals, such as regaining mobility and independence, and social goals, such as shaking hands and

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<sup>16</sup> Craig D. Murrery and Elaine Biddiss, *Amputations, Prosthesis Use, and Phantom Limb Pain: An Interdisciplinary Perspective*. (New York: Springer, 2010), chap. 2.

<sup>17</sup> Murry, Kulkarni and Grady, *Amputations, Prosthesis Use, and Phantom Limb Pain: An Interdisciplinary Perspective*, chap. 9.

<sup>18</sup> Murrery, Schaffalitzky, Gallagher, Desmond, MacLachlan, *Amputations, Prosthesis Use, and Phantom Limb Pain: An Interdisciplinary Perspective*, chap. 5.

wearing wedding rings, are extremely important.<sup>19</sup> This thesis questions how a building can ease these challenges and provide comfort through connection, movement and empowerment.

### Connection

#### *How can the building enable connection?*

This thesis looks at connection as a concept that can not only improve patients' wellbeing, but also inform design. Connection of people, activities and ideas are extremely important in the rehabilitation process and this thesis explores how the building can promote this engagement. This study began with an analysis of literal prosthetic connections and how they can be metaphorically applied in the built environment.

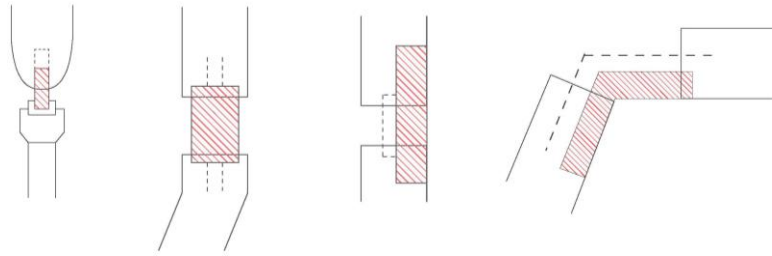
#### Implanted Connection

In an implanted connection the prosthetic is directly implanted into the residual limb. This can allow for new technologies, such as myoelectric prosthetics. This thesis explored simple diagrammatic studies of implanted connection and began exploring how this could transform into the built environment. The drawings questioned how architectural elements, such as circulation, material, mechanical systems, could become the implanted connection between old and new.

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<sup>19</sup> Murrar, Schaffalitzky, Gallagher, Desmond, MacLachlan, *Amputations, Prosthesis Use, and Phantom Limb Pain: An Interdisciplinary Perspective*, chap. 5.

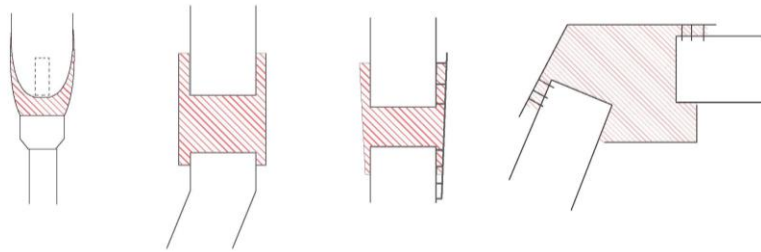




**Figure 3 - Implanted Connection Diagrams** – *Source: Image by Author*

### Socket Connection

In a socket connection the prosthetic wraps around the residual limb. This is common in passive or harness prosthetics. As with the implanted connection, this thesis explored how the connection could inform architectural design through diagrammatic studies. The thesis questions how this connection could physically manifest and spatially inform a built environment and enable its user's ease of occupation.



**Figure 4 - Socket Connection Diagrams** – *Source: Image by author*

### Movement

*How can the building enable movement?*

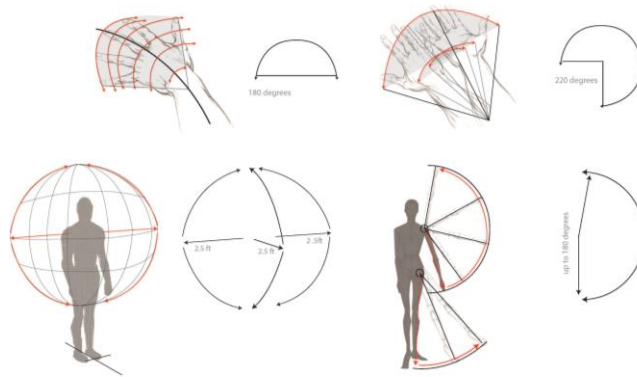
This thesis also looked at movement as an attribute that can not only improve patients' wellbeing, but inform design. Movement of people, systems and ideas are beneficial to not only the rehabilitation process, but in enabling equality and access for the building's occupants. This thesis explores how the building can promote movement at both the larger scale of circulation and building systems, and the smaller scale of the individual and allow ease of occupation for the user. This study began with an analysis of individual movement and body dimensions and how they can be incorporated into the built environment.

#### Upper Limb Studies

The thesis analyzed upper limb movements and dimensions and how they could inform architectural space. Upper limb movements are very intricate and dynamic with “the hands moving[e] so ably over this terrain that we think nothing of the accomplishment.”<sup>20</sup> However, there is a limit to one's reach, approximately 2.5 feet to the sides and front of one's body. This creates an indivisible boundary around each being that can inform a spatial typology in a building.

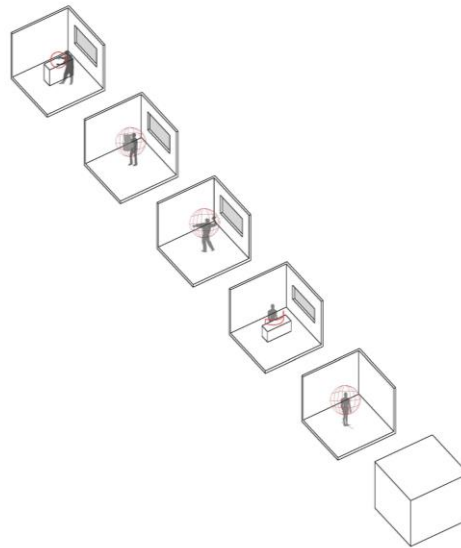
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<sup>20</sup> Frank R. Wilson, *The Hand: How Its Use Shapes the Brain, Language, and Human Culture*, (New York: Pantheon Books, 1998).



**Figure 5 - Upper Limb Studies** – *Source: Image by Author*

From these movement studies, a centralized, inward looking spatial typology is informed. This is incorporated into the design of the building.

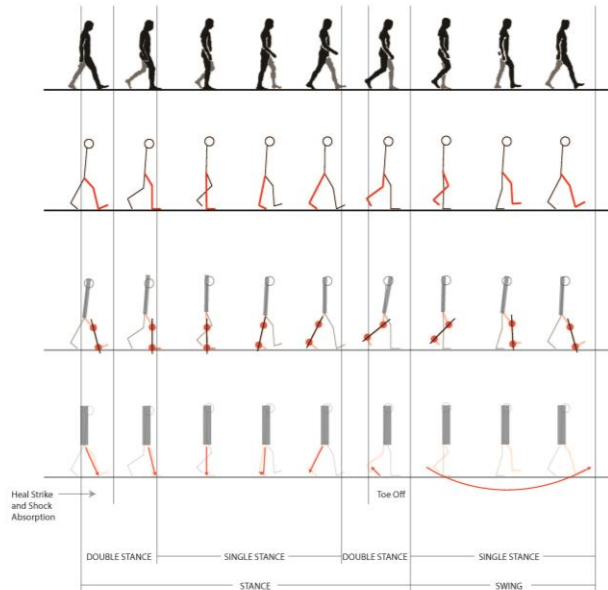


**Figure 6 - Centralized Spatial Typology** – *Source: Image by Author*

### Lower Limb Studies

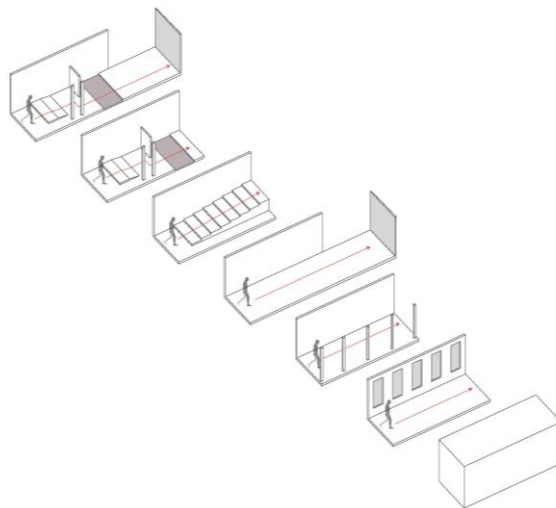
The thesis also analyzed lower limb movements and dimensions and how they could inform architectural space through the analysis of the gait cycle. Perfecting the

gait cycle is very important to prosthetic rehabilitation. The analysis of the gait cycle, and in turn lower limb movements, exhibited a very repetitive, rhythmic motion.



**Figure 7 - Gait Cycle Analysis** – Source: Image by author

There is no boundary to this movement which informs a very linear, outward, or forward, looking spatial typology which influenced the building design.



**Figure 8 - Linear Spatial Typology** – Source: Image by Author

## Empowerment

### *How can the building enable empowerment?*

The idea of empowerment was a driving factor for design strategies in the thesis. The thesis aimed to not only rehabilitate the users of the building, but also enhance their quality of life. Enabling empowerment for the patients is extremely important when thinking about design. The thesis explored how the building can empower its users during their physical, environmental and psychosocial challenges.

#### Physical

The thesis works to provide physical empowerment through the built environment. This includes providing space for the needed rehabilitation equipment, body movements and dimensions, as well as providing easy accessibility to all areas of the building.

#### Environmental

The thesis also works to create environmental connections that enable and empower its users. Connection to nature is proven to increase the healing time in rehabilitation patients.<sup>21</sup> This thesis aims to engage in its natural surroundings, such as Rock Creek Park, for the empowerment and wellbeing of its patients. The location of the building also provides easy access to public transportation, mix-use developments, cultural and educational centers. This enables and empowers patients to occupy and engage with their environment.

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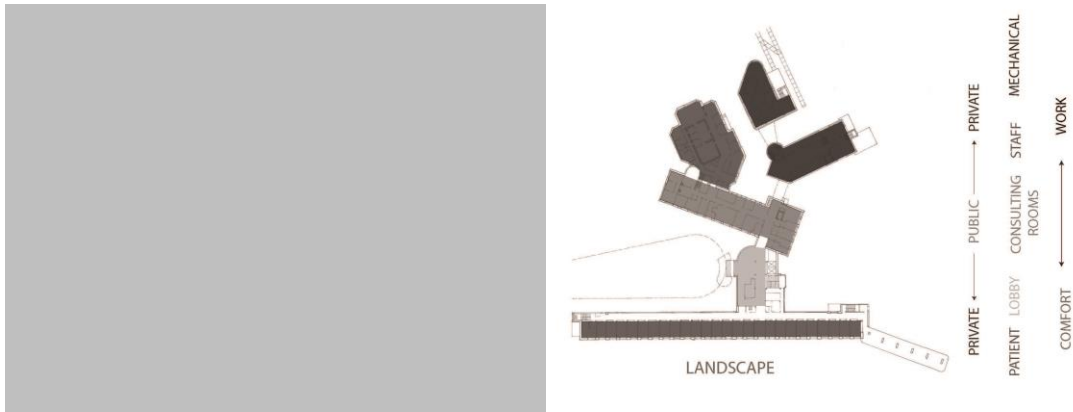
<sup>21</sup> Sternberg, *Healing Spaces: The Science of Place and Well-being*.

## Psychosocial

Lastly, the thesis takes into consideration the psychosocial needs of the patient and questions how the building can heal and empower mindset of its users. Patients experience depression, struggle with body image and become frustrated when engaging with new prosthetic devices. The thesis explores how design implications can improve these hardships through spatial and programmatic techniques such as large, flexible space for collaborative rehabilitation between the patient and staff support team, visitor spaces and day rooms for social support, and individual reflection spaces.

## Chapter 3: Precedents

### Paimio Sanatorium



**Figure 9 – Paimio Sanatorium** – Source: *Architectural Digest*

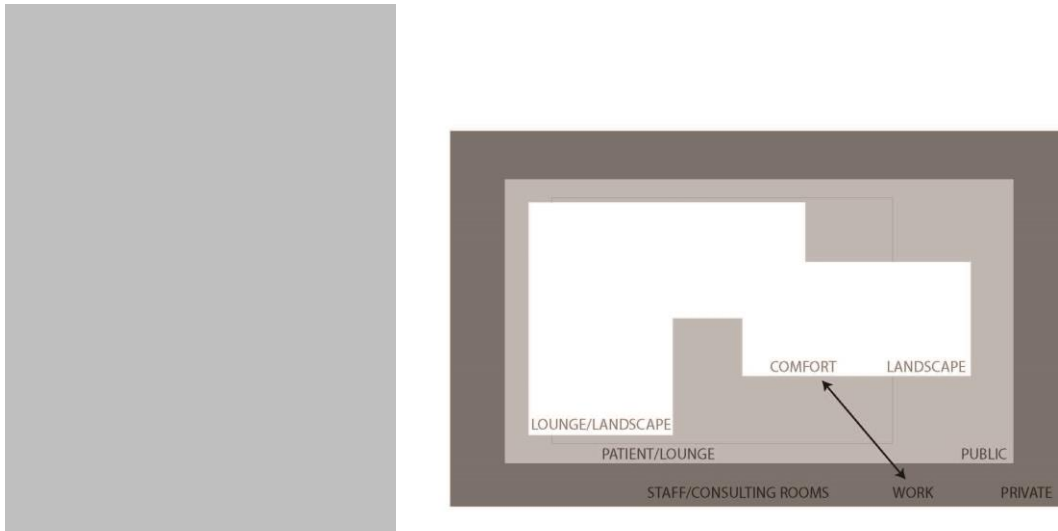
**Figure 10 – Public v. Private Diagram** – Source: *Image by Author*

*“...and his [Aalto] incessant striving to combine architecture with the natural environment and with man, in a harmonious symbiosis. This symbiosis, moreover constitutes the ultimate aim of tuberculosis sanatoria, buildings conceived to cure patients by means of environmental therapies through the sun, pure air, and healthy life in a natural environment.” Cecilia Rubiloba Quecedo<sup>22</sup>*

<sup>22</sup> Cecilia Rubiloba Quecedo, "The Functionalist Awakening of Alvar Aalto in the Kinkomaa Tuberculosis Sanatorium. Each Thing in Its Place and a Distinctive Aesthetic for Each One," *Alvar Aalto Museo*, (January 2, 2013), accessed November 1, 2015, <http://www.alvaraaltoresearch.fi/articles/functionalist-awakening-alvar-aalto-kinkomaa-tuberculosisid/#.Vzycvjfmqpo>

The Paimio Sanatorium was designed by Alvar Aalto in 1929 and built by 1933 in Paimio, Finland. The building was designed as a tuberculosis sanatorium and meant to contribute to the healing process. The long linear form of the patient quarters allowed for daylighting and easy ventilation in the rooms. The placement and angle of the radiating wings was determined by the direction of daylight and views to the landscape. Aalto took great care in the layout and function of the building. He placed the public realms and entrance at the center and let the more private areas radiate from that. He also designed the patient rooms to be at the opposite end of the building from the mechanical and consulting rooms, separating harsher technologies from comforting spaces.

### *Centre for Cancer and Health*



**Figure 11 – Center for Cancer and Health** – Source: Adam Mork, ArchDaily

**Figure 12 – Layers Diagram** – Source: Image by Author

*“Research shows that architecture can have a positive effect on people’s recovery from disease. A human scale and a welcoming atmosphere can help people*



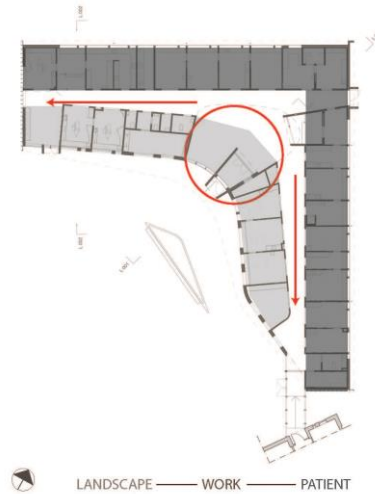
*to get better. Despite of this, most hospitals are hardly comfy. Just finding the way from the reception to the canteen can be difficult. If we want people to get better at our hospitals, we need to deinstitutionalize and create a welcoming healthcare. The Centre for Cancer and Health designed by Nord Architects Copenhagen does just that.” – Nord Architects<sup>23</sup>*

The Centre for Cancer and Health was designed in 2011 by Nord Architects in Copenhagen, Denmark. The center was designed with proportion in mind as the architects wanted to create for the comforting scale of the individual. The building form consists of small house forms assembled into a larger whole. The center seems to turn inward on itself, creating a protective environment for its users. The more private areas, such as the patient and consulting rooms and the offices are located on the exterior of the building forming a type of barrier to the outside world, while the public lounges and courtyard are embraced in the center of the building. This forms a sense of community and protection in the building. This same technique is used in the Livsrum Cancer Counselling Center designed by EFFEKT in Naestved, Denmark and in the Asahicho Clinic designed by Hlk Studio near Chiba, Japan.

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<sup>23</sup> “Centre For Cancer And Health / Nord Architects.” ArchDaily, last modified September 24, 2013, accessed November 1, 2015, <http://www.archdaily.com/430800/centre-for-cancer-and-health-nord-architects>

## Ruukki Health Clinic



**Figure 13 – Ruukki Health Clinic** – Source: Alt Architects/Ville-Pekka Ikola

**Figure 14 – Public v. Private Diagram** – Source: Image by Author

*"Other facades are stylishly nonchalant and functional with ribbon windows providing therapeutic forestscapes to the interior, alongside natural light." – Alt Arkkitechdit<sup>24</sup>*

The Ruukki Health Clinic was designed by Alt Arkkitechdit in 2014 and is located at the edge of a forest in Siikajoki, Finland. The building has a strong connection to the landscape. The architect chose a wood cladding for the façade which acknowledges the surrounding forest. The elevation facing the forest incorporates ribbon windows to provide natural lighting and views. The layout and form of the building embraces the user and provides an open feel and easy

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<sup>24</sup> Jessica Mars. "Curved Wood Wall Fronts Ruukki Health Clinic by Alt Arkkitechdit," Dezeen Curving Wooden Wall Fronts Ruukki Health Clinic in Finland by Alt Arkkitechdit Comments, last modified May 29, 2015, accessed November 2015, <http://www.dezeen.com/2015/05/29/ruukki-health-centre-medical-clinic-alt-arkkitechdit-finland-forest-meandering-timber-wall/>

circulation. The central lobby in the L-shaped form allows for ease of orientation in the building and creates a core that unites different program uses.

*Belmont Community Rehabilitation Center*



**Figure 15 - Belmont Community Rehabilitation Center** –Source: Tony Miller, ArchDaily

**Figure 16 - Public v Private** – Source: Image by Author

*“Sitting in a garden setting, a new mobility garden provides external rehabilitation facilities and seating in a wind protected sunny courtyard between the new Rehabilitation Centre and existing Community Health Centre.” – Billard Leece Partnership<sup>25</sup>*

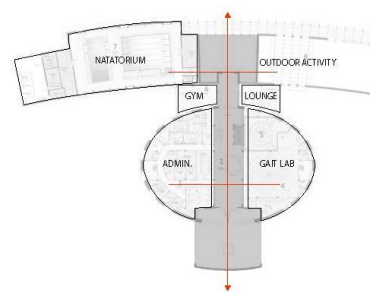
The Belmont Community Rehabilitation Centre was designed by Billard Leece Partnership in 2012 and is located in Belmont, Australia. The building is set on a prominent corner in a residential neighborhood and is connected by pedestrian paths to the Community Health Centre. The building uses material and form to engage the surroundings. The architects acknowledged the solar orientation and designed large

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<sup>25</sup> "Belmont Community Rehabilitation Centre / Billard Leece Partnership," ArchDaily, last modified September 29, 2013, accessed Nov 2015, <http://www.archdaily.com/431771/belmont-community-rehabilitation-centre-billard-leece-partnership>

windows in each room to provide natural light and ventilation. The windows are equipped with dynamic folded sun shades. The building is laid out in a way that embraced a central garden and public space and a layering system from the public garden to the patient rooms is evident which allows for patient privacy.

### *The Centre for the Intrepid*



**Figure 17 – Centre for the Intrepid – Source: SmithGroup JJR**

**Figure 18 – Program Diagram – Source: Image by Author**

*"The quality of the design and the space is extraordinary. It doesn't have a healthcare feeling."<sup>26</sup>*

The Centre for the Intrepid – National Armed Forces Physical Rehabilitation Center was design by SmithGroup JJR and is located in San Antonio, Texas. The building, built in 2006, is a 65,000sqft prosthetic rehabilitation facility for those serving in the National Forces.<sup>27</sup> The building provides programmatic information for this thesis. The program includes: patient lounges, laboratories and therapy

<sup>26</sup> "Interpid Fallen Heroes Fund," SmithGroup JJR, The Centre for the Intrepid, last modified 2014, accessed February 2016, <http://www.smithgroupjjr.com/projects/center-for-the-intrepid#5>.

<sup>27</sup> "Interpid Fallen Heroes Fund," SmithGroup JJR, The Centre for the Intrepid

treatment spaces, advance prosthetic research and computerized video monitoring, virtual reality simulators of Activities of Daily Living, labs for prosthetic fittings and adjustments, psychotherapy rooms, a gait study lab, a therapy pool and an outdoor exercise space. The building allows for an analysis of spatial layout, room sizes, and a look into the yield of an advance prosthetic facility.

## Chapter 4: Program

### History and Social Issues

*“Can we design places so as to enhance their healing properties? And if we ignore the qualities of physical context, could we inadvertently slow the healing process and make illness worse?” – Esther M. Sternberg<sup>28</sup>*

Today, medical centers are struggling with a disconnect between the building and user. Many hospitals, hospices, and rehabilitation centers are sterile and uncomfortable making it hard to imagine a healing, comforting response to their environments. In the 19<sup>th</sup> century hospitals were built with a lack of electric-lighting and technology. In many ways this created better environments for the patients. Doctor and nurse’s main focus was on the patients and their wellbeing. The hospitals were built with large windows and skylights to provide the needed light and a connection to the outdoors. A study published in *Science* magazine in 1984, showed that when hospital rooms have windows looking out on the natural world, patients heal more rapidly.<sup>29</sup> Many hospitals also had a “solarium”, which is a room where

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<sup>28</sup> Sternberg, *Healing Spaces the Science of Place and Well-being*.

<sup>29</sup> R. S. Ulrich, “View through a window may influence recovery from surgery.” *Science*, 224 (4647): 420-421. (1984)

patients could sit and absorb the healthful rays of natural sunlight.<sup>30</sup> Once a rise of new technology began in the mid-twentieth century, the reliance on and importance of new machinery took priority.

As the awe of the new medical technology increased, the comfort of patients was pushed aside and their surrounds were often ignored.<sup>31</sup> Medical centers were being built with technology and machinery in mind as oppose to the users of the spaces. This is where most of the modern problems of medical facilities lie. A disregard for the users only creates a building with walls and rooms in which to be, not spaces and environments in which to grow and heal in. Hospital planners in the mid-twentieth century assumed that patients could adapt to the needs of the new technologies, rather than adapting the new technologies to the patient's needs.<sup>32</sup> As designers we need to reverse this role. We need to shift the focus from the disease to the patient and from the diagnosing to the healing.

At a Workshop at Woods Hole, architects, neuroscientists and psychologists met to do just that. The group studied how physical surroundings affect emotions and how in turn these emotions affect health. They believed that "If they could understand how physical surroundings affect emotions and how emotional responses to architecture affect health, then people's health could be taken into account in the design of buildings."<sup>33</sup> The program and spaces of this project are attempting to test that. If we can build spaces that enable connection, movement and empowerment,

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<sup>30</sup> Sternberg, *Healing Spaces the Science of Place and Well-being*.

<sup>31</sup> Sternberg, *Healing Spaces the Science of Place and Well-being*.

<sup>32</sup> Sternberg, *Healing Spaces the Science of Place and Well-being*.

<sup>33</sup> Sternberg, *Healing Spaces the Science of Place and Well-being*.

then we can provide spaces that evoke comfort, initiate healing and respond to the changing emotions of its users.

Physical rehabilitation can be both physically and mentally demanding. It is important to create an environment that inspires the patient and promotes success and growth. Many patients who are in need of prosthetic rehabilitation after amputation experience a loss of independence which can be emotionally difficult. A patient needs family, friends, doctors and nurses to help encourage his healing and growth. “There is a considerable body of literature identifying the needs of family members (Engli & Kirsivali-Farmer, 1993; Mathis, 1984; Molter, 1979; Verhaeghe et al., 2005).”<sup>34</sup> An important part of the program for this thesis is the spaces for these supporting members and staff. Visitors should feel welcomed and comfortable and given adequate spaces to give their support and encouragement.

### Program Objectives

The programmatic design objectives of this project are to create comfortable spaces that promote growth and inspire healing through enabling connection, movement and empowerment. The program layout and design emphasizes the scale and movement of the human body in a way that maximizes these design objectives and brings the patient to the forefront of the design. Secondly, the programmatic design works to create adequate spaces for the physical, environmental and psychosocial needs of the patient. Making a patient’s support group feel welcomed and comfortable is crucial to the creation of an encouraging environment. When

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<sup>34</sup> Ulrich, Zimring, Zhu, Dubose, Seo, Choi, Quan, and Joseph. "A Review of the Research Literature on Evidence-Based Healthcare Design." *HERD: Health Environments Research & Design Journal* 1, no. 3 (2008): 61-125.



laying out the program objectives such as convenience, circulation and movement, and room relations will have a major effect on how the user experiences the building.

Programmatic Objectives:

1. Enable connection, movement and empowerment for occupants
2. Create comfortable, healing spaces
3. Create adequate spaces for visitors, family, doctors and nurses
4. Prioritizing convenience, circulation and room relations to enable equivalence among users

Initial Program Options Analysis

Outpatient Rehabilitation Center

Outpatient rehabilitation centers usually have a wider variety of rehabilitation types. These can range from minor injuries and post-surgery, to brain trauma and amputee rehabilitation. These facilities are usually smaller as they do not need overnight patient beds, storage, or personal space and often require less medical equipment and treatments. The building also has a closing time and does not need to function 24 hours a day which lessen its mechanical needs.

Inpatient Rehabilitation Center

Inpatient rehabilitation centers typically have a more specific program focus and are usually larger in square footage. The building needs overnight rooms for patients and staff, possible overnight spaces for the patient's family and visitors, dining facilities with a kitchen, and rooms for group classes and individual time.

Individual time and personal space is important as while visitors provide a boost in the healing process, they are also draining for the patient.<sup>35</sup> Therapeutic spaces may be needed in the program. Since the patients will be in the facility for longer periods of time, the rooms should be comfortable and home-like with places for personal storage and decorations.

#### Both Inpatient and Outpatient Rehabilitation Center

Both inpatient and outpatient centers require offices and staff spaces, lounges and day rooms for patients and visitors, patient rooms and personal, therapeutic spaces, and workout and exercising rooms. This combination allows for a successful balance of users for this thesis exploration of a prosthetic rehabilitation center. The thesis takes into consideration physical, occupational, and vocational therapy.

Occupational therapy, which focuses on rebuilding the deficits and finding workaround to allow the patients to continue to perform everyday tasks, usually requires kitchens, bathrooms, and work environments which help the patient practice the life skills that they will need.<sup>36</sup> The building should also have plenty of storage spaces and enough room for mechanical and technological needs.

As stated, prosthetics rehabilitation is a growing field and there are many new technologies within it, including myoelectric and 3D printed prosthetics. A new rehabilitation center should keep these new technologies in mind and make room for growing ideas.

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<sup>35</sup> Sternberg, *Healing Spaces: The Science of Place and Well-being*.

<sup>36</sup> "Regenerative Rehabilitation," American Physical Therapy Association, last modified September 9, 2015, accessed October 28, 2015, <http://www.apta.org/RegenerativeRehab/>.

## Program

### Program Summary

This thesis creates an inpatient rehabilitation center that specialized in amputee and prosthetic rehabilitation. The building consists of three main programmatic elements: Rehabilitation, Research and Rest. The rehabilitation part of the building is very active, full of interaction between patients, therapist, and researchers. Here, patients experience the struggles and frustration of engaging with a new prosthetic limb, but also the success and satisfaction of reaching their goals. This area of the building includes open, flexible rehabilitation space, semi-private and private space, and gait and occupational rehabilitation.

The research area of this building includes the research of new prosthetic technologies, the manufacturing of prosthetics and fitting/adjustment rooms for the patients. Here, patients can interact with the production and fitting of new prosthetics. This enables empowerment and a sense of reassurance for the occupants.

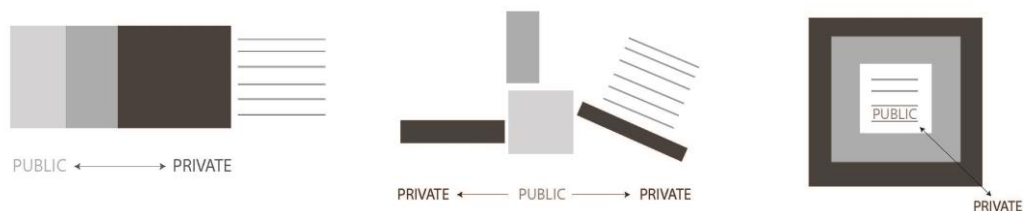
The rest space of the building is very important. After a long day of struggling with a new device, the patients need an area of retreat and relaxation. These spaces include a day room, a visitor lounge, a private, individual reflection space, and the inpatient rooms.

The building also moves from public spaces including: a lobby, reception area, and waiting rooms, to semi-public spaces including: visitor lounges, dayrooms, and a dining area, to private spaces including: patient rooms, consulting rooms, day rooms, and workout facilities, and support spaces. The layout of the spaces work to

create easy circulation between staff and patient, layer the movement from public to private, and study the interaction between technology, work, social and comfort.

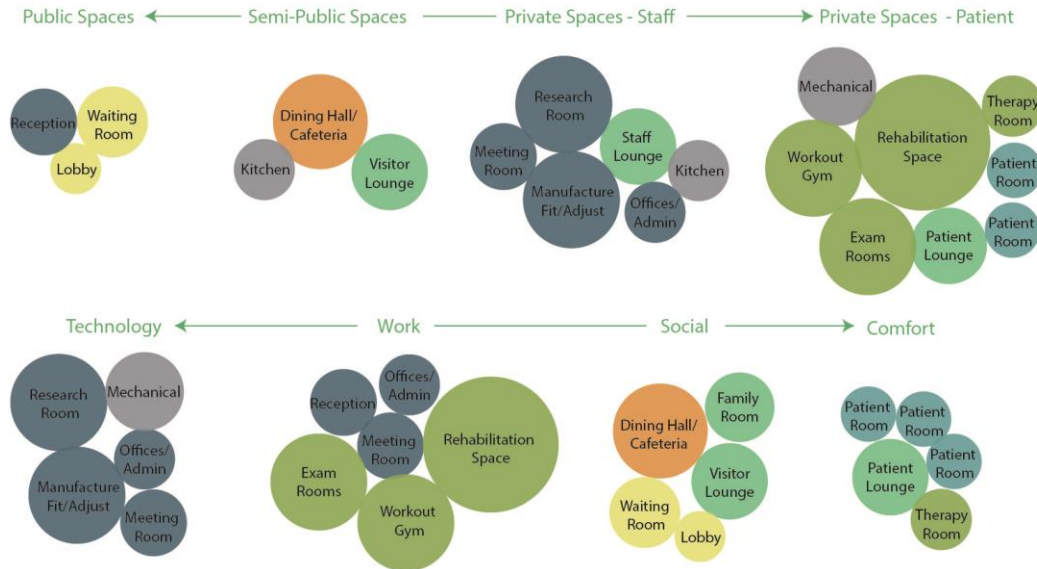
Research	
Advance Prosthetic Research Laboratories	1,200 sqft
Manufacturing of Prosthetics	2,000 sqft
Labs for Prosthetic Fittings and Adjustments	500 sqft
Rehabilitation	
Consulation and Examination Rooms	100 sqft (x5)
Psychotherapy/Vocational Therapy Rooms	240 sqft (x4)
Electromyograpity/Special Treatment Rooms	250 sqft (x3)
Group Council/Group Education Room	770 sqft
Activities of Daily Living (ADL)	600 sqft
Physical Therapy - Flex Space	19,000 sqft
Gait Studies/Training	4,000 sqft
Workout/Gym Equipment Area	3,000 sqft
Occupational Therapy	1,800 sqft
Semi-Private Mats/Tables	200 sqft (x4)
Private Mats/Table Rooms	230 sqft (x2)
Therapy Tub Room	150 sqft
Outdoor Activity Area	
Rest	
Day Room/Visitor Lounge	850 sqft
Patient Rooms	250 sqft (x10)
Patient Lounge/Individual Refection Space	770 sqft
Dining Area	850 sqft
Staff Lounge	230 sqft
Staff Kitchen	180 sqft
Support	
Lobby/Reception/Waiting Room	1,400 sqft
Offices/Administration	1,240 sqft
Kitchen	400 sqft
Patient Bathrooms	50 sqft (x10)
Locker Rooms + Bathroom	240 sqft (x2)
Bathrooms	120 sqft (x4)
Storage	600 sqft
Mechanical	1,000 sqft

**Figure 19 - Program Tabulation** – Source: Table by Author



**Figure 20 - Public v. Private Diagrams** – Source: Image by Author

## Program Graphic Depiction



**Figure 21 - Programmatic Studies** – *Source: Image by Author*

## Programmatic Design Research

This thesis began with taking into account the following considerations from “A Review of the Research Literature on Evidence-Based Healthcare Design”<sup>37</sup> when planning the programmatic design and layout of the building:

### Impact of Noise and Lighting on Medical Errors

This will include reducing patient falls that are commonly caused by inept lighting, floor materials, etc.

### Improving Other Patient Outcomes through Environmental Measures

<sup>37</sup> Ulrich, Zimring, Zhu, Dubose, Seo, Choi, Quan, and Joseph. "A Review of the Research Literature on Evidence-Based Healthcare Design." 61-125.

This includes applying research and evidence such as, the positive effect of exposing patients to nature and natural daylighting, the effects of noise on patients, and how patients circulate and find their way through a healthcare center best, when designing the programmatic layout. Addressing these issues will work to reduce the pain, stress, depression and spatial disorientation of the patients.

#### Improving Communication with Patients and Family Members

This includes creating spaces that will foster social support or family members and friends and creating spaces that give the physical environment a role in encouraging social support. To achieve this, the building will include social interaction spaces such as lounges, day rooms, comfortable waiting rooms, movable furniture, flexible spaces and single bed rooms.

#### Improving Staff Outcomes through Environmental Measures

The staff is a very important component to the program and design. Keeping the staff of the building comfortable and designing spaces that are easy to work in is critical to creating a healing environment. This topic includes incorporating lifts and ADA accessibility to help easily move patients. Incorporating natural daylight, designing to decrease noise and distractions and studying unit configuration are some of the ways to decrease staff stress and increase staff effectiveness.



**Figure 22 - Design Factors and Healthcare Outcomes** – Source: “A Review of the Research Literature on Evidence-Based Healthcare Design”

*The Architecture of Medical Imaging: Designing Healthcare Facilities for Advance Radiological Diagnostic and Therapeutic Techniques* states that there are four key ingredients of a good facility design: Convenience, Image, Flexibility, and Economy.<sup>38</sup> This thesis seeks to satisfy these four ingredients to create a comfortable, healing space for rehabilitation patients.

The most important factor contributing to a patient’s impression of a facility is convenience.<sup>39</sup> The design should be laid out in a way that is simple to navigate from parking and drop off spaces to and through the building. The building

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<sup>38</sup> Bill Rostenberg and Steven C. Horii, *The Architecture of Medical Imaging: Designing Healthcare Facilities for Advanced Radiological Diagnostic and Therapeutic Techniques*, (Hoboken, N.J.: John Wiley & Sons, 2006).

<sup>39</sup> Rostenberg and Horii, *The Architecture of Medical Imaging: Designing Healthcare Facilities for Advanced Radiological Diagnostic and Therapeutic Techniques*.

should be easy to access and visible from the surrounding area. Accessibility at all levels is important (pedestrian, vehicular and public transit) and ample patient and visitor parking (including parking for ADA) that is close to the building is needed. For the patient and visitors, there should be clear signage and architecture cues within the building so that one may easily find his way around. This can be emphasized by lighting, sight lines, sounds, etc. It is also important to think about the staff convenience of the building. Dr. Leonard Berry states that “A well-designed physical environment has a positive impact on employees as well, reducing physical emotion stress-which is off value not only to employees, but also to patients because visible employee stress sends negative signals”.<sup>40</sup>

The identity of the building, especially in the eyes of the patient, is important. “Ideally, the design of a medical facility tells a compelling story about the service that the service cannot tell by itself. The facility communicates a torrent of clues about that services; it is a physical reflection of the core values and quality of care offered by the institution.”<sup>41</sup> Technology and medical equipment can create a cold and unfamiliar feeling in a space. This can construct an impersonal, uncomfortable atmosphere for the users. Bill Rostenberg, author of *The Architecture of Medical Imaging: Designing Healthcare Facilities for Advance Radiological Diagnostic and Therapeutic Techniques*, states that there are three ways to deal with technology in a building: Softening Technology, Emphasizing Technology, and Neutralizing Technology. Softening technology is a technique to soften the harshness of medical

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<sup>40</sup> Rostenberg and Horii. *The Architecture of Medical Imaging: Designing Healthcare Facilities for Advanced Radiological Diagnostic and Therapeutic Techniques*.

<sup>41</sup> Rostenberg and Horii. *The Architecture of Medical Imaging: Designing Healthcare Facilities for Advanced Radiological Diagnostic and Therapeutic Techniques*.



equipment throughout the building to relieve the sense of alienation that it may establish. This can largely be done through design techniques such as controlling acoustics through the manipulation of room shapes and sizes and door placement.<sup>42</sup> Some facilities may want to emphasize their technology. Many patients place confidence in technological advances in modern medicine.<sup>43</sup> However, if a building is proposing to emphasize its technology and medical equipment, they must keep in mind human scale and comfort. Neutralizing technology is a blending of the two which is where this thesis lies. Keeping the patient comfortable is the main priority, but bringing to light the new technologies and techniques is important to give confidence in the facility.

Flexibility and economy will be considered in this project. When designing the building flexibility for future changes is important. The building will have movable elements, places for future expansion and implement the Integrated Building System (IBS). Economically wise, the building design will take into consideration: assigned and unassigned spaces, activity, support and administration spaces, and revenue and non-revenue generating spaces.

### *Programmatic Prosthetic Rehabilitation Design Research*

The thesis takes multiple levels of prosthetic rehabilitation into account during the programming phase. This includes timing, coping strategies, rehabilitation goals, rehabilitation team, and maintenance needs.

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<sup>42</sup> Rostenberg and Horii. *The Architecture of Medical Imaging: Designing Healthcare Facilities for Advanced Radiological Diagnostic and Therapeutic Techniques*.

<sup>43</sup> Rostenberg and Horii. *The Architecture of Medical Imaging: Designing Healthcare Facilities for Advanced Radiological Diagnostic and Therapeutic Techniques*.

## Timing

Timing and length of patient stay is important in the programmatic design of the thesis. Prosthetic rehabilitation should begin within a maximum of five working days after the patient receives the prosthesis.<sup>44</sup> After one year, an amputee becomes established; however, pain and prosthetic adjustments may still occur. Time and vocational therapy are closely linked as well. Patients with lower limb amputations require nine months to 2.3 years before returning to work versus five days to 24 months in upper limb patients. Furthermore, studies show that if the time between amputation and first fitting is longer than twelve weeks, patients are less likely to work again.<sup>45</sup> The thesis incorporates space for vocational therapy to allow for patients to quickly return to work and engage in society.

## Coping Strategies

Physical, environmental and psychosocial coping strategies also inform programmatic design. Physically, the building provides space for physical therapy, mirror techniques, and virtual environment coping strategies. Environmentally, the design allows for direct connection with the surrounding environment in the form of outdoor practice space. Psychosocially, the thesis incorporates spaces for group therapy and education as well as social support.

## Rehabilitation Goals

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<sup>44</sup> Anne Holliday and Kirsty Solvay, "Amputee Rehabilitation Guidelines for Physiotherapists Version 10," *Torbay and South Devon, NHS Foundation Trust*, (2014), accessed March 2016, <http://www.torbaycaretrust.nhs.uk/publications/TSDHC/Amputee%20Rehabilitation%20Guideline%20for%20Physios.pdf>.

<sup>45</sup> Murrury, *Amputations, Prosthesis Use, and Phantom Limb Pain: An Interdisciplinary Perspective*.

Rehabilitation goals such as: getting on and off the floor, obstacle crossing, going up and down stairs, curbs, ramps and slopes, walking in a crowded environment, carrying an object whilst walking, walking over uneven outdoor ground, changing speed and direction, opening and closing a door, and picking up objects from the floor all inform programmatic and spatial design in the thesis. They help to define spatial typologies (*see Figure 8*) that influence the design of the building.

#### Rehabilitation Team

Prosthetic rehabilitation requires a large team and support system of which this thesis works to accommodate. The rehabilitation is primarily coordinated by a prosthetist and an interdisciplinary team of health care professionals including psychiatrists, surgeons, physical therapists, and occupational therapists.<sup>46</sup> The thesis explores how to provide space for a wide variety of staff, patients and visitors and enable equivalence for each occupant.

#### Maintenance Team

Maintenance, repairs and adjustments of prosthetics are extremely important to the rehabilitation process. Individuals who are fitted with prosthesis within two years of birth or within six months of amputation are significantly more likely to continue prosthetic use.<sup>47</sup> Also, including the individual in the choice of prosthesis greatly enhances the possibility that the prosthetic will be accepted and used.<sup>48</sup>

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<sup>46</sup> Holliday and Solvay, "Amputee Rehabilitation Guidelines for Physiotherapists Version 10."

<sup>47</sup> Murrar, *Amputations, Prosthesis Use, and Phantom Limb Pain: An Interdisciplinary Perspective*.

<sup>48</sup> Murrar, *Amputations, Prosthesis Use, and Phantom Limb Pain: An Interdisciplinary Perspective*.

## Chapter 5: Building Technique

### *Structure and Mechanical Implications*

The structure of the building is also influential to the connection, movement and empowerment of its users. A metaphorical reference to prosthetic limbs, the programmatic elements of rehabilitation space with exercising equipment and the need for large windows and ample natural lighting are all taken into consideration when analyzing the building structure. The structural system also takes into account human scale and familiarity. Repeating patterns and repetition are pleasing to human sight and experience.<sup>49</sup>

Noise is a major factor in hospital and rehabilitation design. The placement and control of the mechanical systems, the materials used, and the size of the rooms all have an effect on how noise travels throughout the building. Many patients crave silence and peace as sounds may have many emotional and therefore healing responses.<sup>50</sup>

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<sup>49</sup> Sternberg, *Healing Spaces the Science of Place and Well-being*.

<sup>50</sup> Sternberg, *Healing Spaces the Science of Place and Well-being*.

### Building Code Analysis

One of the most important building codes applicable to this project is ADA regulations. As most of the patients are disabled, the building must be completely ADA compliant. According to accessibility codes, ample patient and visitor parking should be located within 200 feet of the entrance to the building, disabled parking must be adjacent to these entrances, and all paths to these entrances should be level and protected from adverse weather conditions.<sup>51</sup> The programming and design of the building should also be aware of the Health Insurance Portability and Accountability Act (HIPPA) and be sure that there is proper privacy protection in the form of patient information storage, security and room privacy.

### Sustainability

#### Living Systems

Lastly, the project incorporates aspects of sustainability as a sustainable building can be a reflection of the human body. The landscape surrounding the building engages the user and creates a living system of water filtration.

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<sup>51</sup> Rostenberg and Horii. *The Architecture of Medical Imaging: Designing Healthcare Facilities for Advanced Radiological Diagnostic and Therapeutic Techniques*.

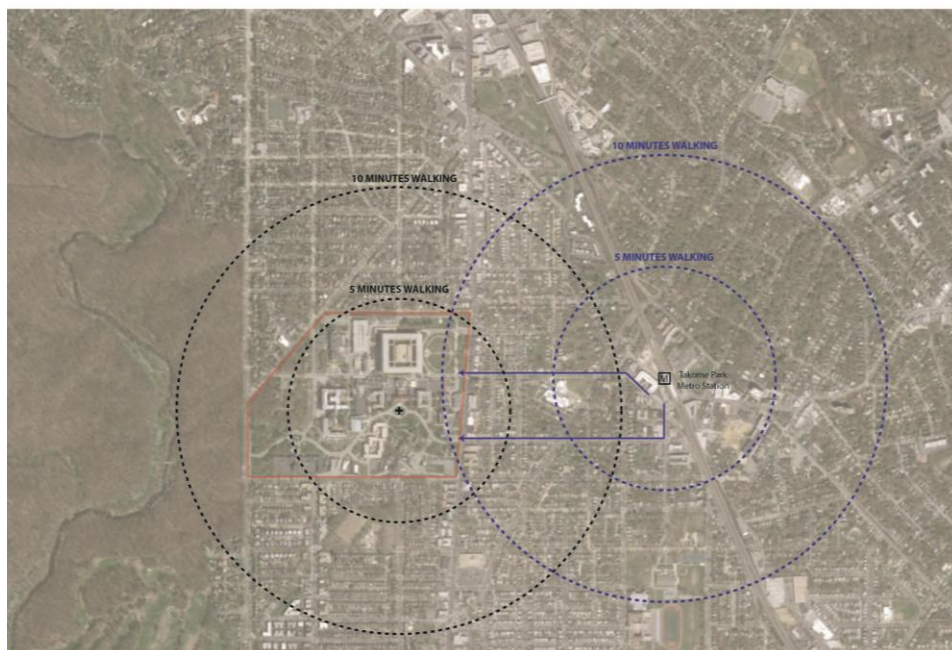
## Chapter 6: Site

### Site Description

This project is located on the site of the former Walter Reed Army Medical Center (WRAMC) in northern Washington, D.C. approximately two miles south of Downtown Silver Spring, Maryland. The former center sits on a 110 acre site surrounded by the neighborhoods of Shepherd Park, Takoma, and Brightwood. Two major roads run along the west and east of the site: Georgia Avenue to the east and 16<sup>th</sup> Street to the west. Georgia Avenue serves as a major north-south commercial thoroughfare in Washington D.C. while 16<sup>th</sup> street borders Rock Creek Park. The Red Line of the Metro runs near the site, with the Takoma Station approximately  $\frac{3}{4}$  mile away.



**Figure 23 - Walter Reed Site Context** – Source: Underlay Google Earth, Diagram by Author



**Figure 24 - Walking Distances** – Source: Underlay Google Earth, Diagram by Author

### Site History

In the 1880's, J.D. Cameron, an American politician, purchased 131 acres of land between 7<sup>th</sup> Street and Rock Creek and in 1905 110 acres of this was purchased for the Walter Reed Army Medical Center.<sup>52</sup> The site not only included the central hospital, but also a medical school, museum, library and a number of administration offices. The first building, the central hospital and administration building, was completed in 1908 and still stands on the site. The building included offices, operating rooms, a kitchen and rooms for up to 75 patients. From 1920-1922 an addition 44 acres were purchased which lead to the construction of a new Army Medical Center Building in 1924 and an increase in capacity from 121 patients to 2,500. A final, new hospital building was built on the site in 1977.<sup>53</sup>



**Figure 25 - Walter Reed Development** – Source: *The Parks at Walter Reed: The Legacy of Tomorrow*<sup>54</sup>

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<sup>52</sup> “History,” Walter Reed Army Medical Center: Local Redevelopment Authority, last modified 2015, accessed December 2015, <http://www.walterreedlra.com/background.history>.

<sup>53</sup> “History,” Walter Reed Army Medical Center: Local Redevelopment Authority.

<sup>54</sup> “The Parks at Walter Reed: *The Legacy of Tomorrow*,” Torti Gallas and Partners, last modified 2015, accessed December, 2015, [http://aiadc.com/sites/default/files/UDMP6%20WalterReed--m\\_low.pdf](http://aiadc.com/sites/default/files/UDMP6%20WalterReed--m_low.pdf)





**Figure 26 - Historic Buildings** – Source: *Underlay Graphical Information System (GIS) Washington D.C., Image by Author*

There are a few historical buildings on the site that will be taken into consideration when proposing a new building site. The first is the central hospital, located to the north of a historical, central green space. The others include a number of administrative and office buildings.

The hospital took in army and civilian patients, including a number of prominent figures such as President Eisenhower and General Douglas MacArthur throughout its 102 year reign. There is a rich history rooted in the buildings and site, but unfortunately the complex has been dormant since the hospital moved to Bethesda in September 2011.

### Site Planning

Today there is a plan to give the site new life. The site, which has long been secluded, will regain connection with the surrounding neighborhoods of single-family

detached homes, garden apartments and row houses. The area is being redeveloped to include residential, retail, offices, a science center, restaurants, a hotel, a conference center and 20 acres of open space. The “Parks at Walter Reed” is set to break ground in 2017.<sup>55</sup>



**Figure 27 - Existing Plan (left) and Proposed Plan (right)** – Source: *The Redevelopment of Walter Reed: A Primer*, Walter Reed Local Redevelopment Authority<sup>56</sup>

The organization of the site is divided into five layers from north to south: neighborhood scale, city/urban context, axial/formal American institutional, pastoral/open/lyrical, and perimeter scale/topographical variety. This allows a smooth transition from the neighborhood scale to the institutional scale, a variety of amenities connected to Georgia Ave, and designated open space within the urban context.

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<sup>55</sup> Eugene Meyer, “Grand Vision for Former Home of Walter Reed Hospital.” *New York Times*, November 19, 2013, accessed December 2015.  
[http://www.nytimes.com/2013/11/20/realestate/commercial/grand-vision-for-former-fome-of-walter-reed-hospital.html?\\_r=0](http://www.nytimes.com/2013/11/20/realestate/commercial/grand-vision-for-former-fome-of-walter-reed-hospital.html?_r=0).

<sup>56</sup> “The Redevelopment of Walter Reed: A Primer,” Walter Reed Local Redevelopment Authority, last modified 2015, accessed December, 2015, [www.walterreedlra.com](http://www.walterreedlra.com)



**Figure 28 - Site Organization** – *Source: Walter Reed Army Medical Center, Local Redevelopment Authority*<sup>57</sup>

Hines, a national firm based in Houston, along with Urban Atlantic and Trident, are leading the new 3.1 million square feet of development which will sit on 66.7 acres. The breakdown of the project includes: 2,097 residential units, including housing for the elderly and homeless, 250,000 square feet of retail space, and 90,000 square feet of offices.<sup>58</sup> Hines plans to preserve the historical buildings on the site such as the original central hospital. This will house institutional, educational, corporate or medical reuse.

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<sup>57</sup> "Walter Reed Army Medical Center: Local Redevelopment Authority." Walter Reed LRA, last modified 2015, accessed December 14, 2015. <http://www.walterreedlra.com/>.

<sup>58</sup> Eugene. "Grand Vision for Former Home of Walter Reed Hospital."



**Figure 29 - Illustrative Site Plan – *The Parks at Walter Reed: The Legacy of Tomorrow***

The illustrative site plan is divided into eight ‘neighborhoods’. The first to the north, Fern Park, sits within the neighborhood scale of the site organization and therefore consist of townhomes. Pershing Park (2) incorporates a linear park in place of the historic garden that once fronted the central hospital building. This creates a strong axial connection between 13<sup>th</sup> Street and the center of the site. Eisenhower Village (3) is a mixed-use town center that includes retail, multi-family residential and a grocery store. The Walter Reed Commerce and Science Park (4) sits within the institutional area of the site. It includes a hotel, conference center, new office buildings and the Bio-Science and Health Research Employment Center while to the east, Lincoln’s Landing (5) works to reactivate Georgia Ave. Aspen Arts Park (6), Benjamin O. Davis Legacy Park (7) and Rock Creek Woods (8) all sit within the open/pastoral, topographical variety section of the site. Aspen Arts Park reinforces the historical open green and provides a new pond and outdoor sculpture park. To the

west, Benjamin O. Davis Legacy Park and Rock Creek Woods reuse historical buildings to provide educational purposes and new housing.

### Site Selection

This thesis will work within the proposed plan for the site. The rehabilitation center will work to make a connection between the medical history of the site and the new potential of community and allow for patients to transition from their past medical procedures to a new lifestyle.

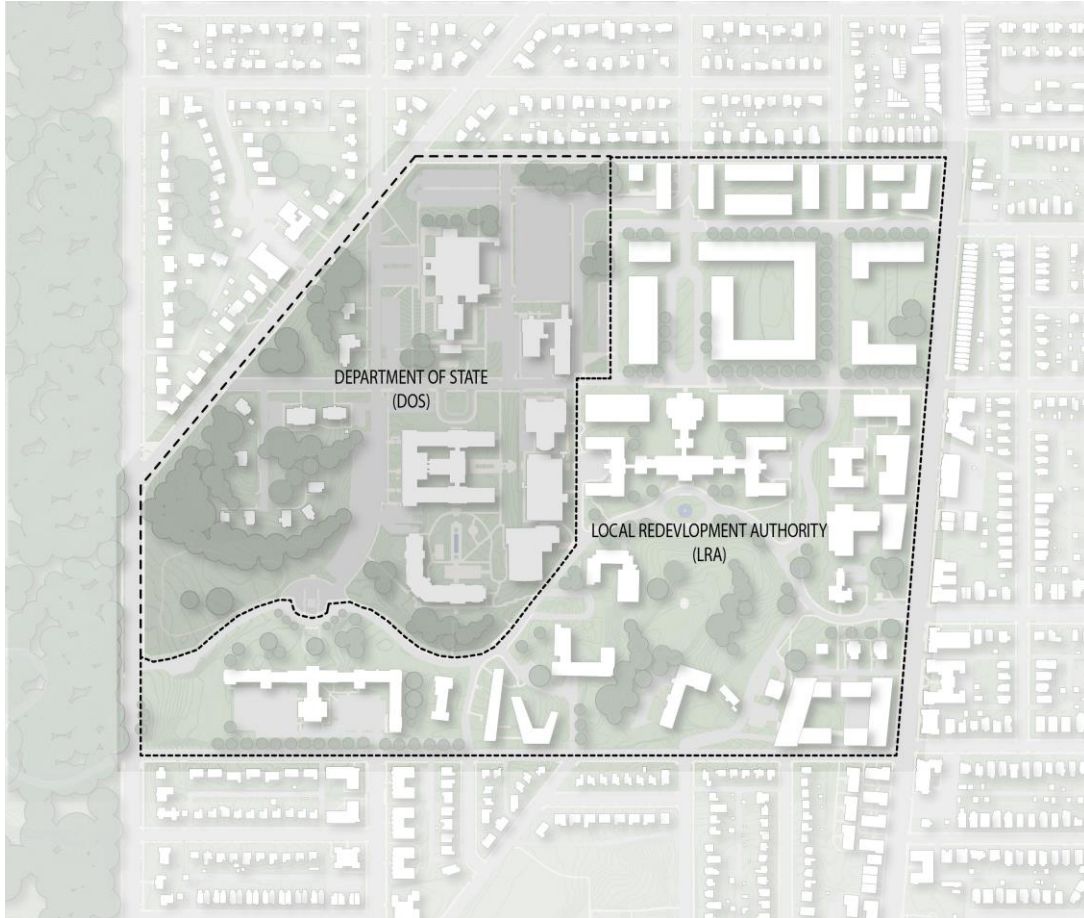
The building site will work to engage the many amenities that the site provides. The Bio-Science and Health Research Employment Center, Aspen Arts Park, Rock Creek Park, walking trail, residential community and culture of Georgia Ave are all provide resources that the program of the building can engage in. The location of the building will be on the southern part of the site, the pastoral/open/lyrical, and perimeter scale/topographical variety areas of the site organization. Having direct access to open spaces, such as the park, pond or walking track, is important for the program of the building.



**Figure 30 - Torti Gallas and Partners, Inc. Proposed Master Plan** – *Source: Underlay GIS Washington D.C., Information from Walter Reed Army Medical Center, Local Redevelopment Authority, and Image by Author*

## Site Analysis

Site boundaries, setbacks, right of ways



**Figure 31 - Site Occupations** – Source: Underlay GIS Washington D.C., Information from Walter Reed Army Medical Center, Local Redevelopment Authority, and Image by Author

The former Walter Reed Army Medical Center was completely owned by the Federal Government up until 2009. Four years after making the decision to move WRAMC to Bethesda, the Department of State (DOS) made a portion of the land available to the Local Redevelopment Authority (LRA). Since then, the committee has been working on the adaptive reuse plans. This thesis will mainly focus on the LRA portion of the site, but may consider locations within the DOS zone.





**Figure 32 - Road Right of Ways** – Source: *Underlay DC Atlas Plus*<sup>59</sup>, Image by Author

Georgia Ave and 16<sup>th</sup> have strong street right of ways enclosing the site. New right of ways have been introduced to the site, including a more prominent pedestrian right of way that was once restricted to the residential zones on the outskirts. Parking is heavy near Rock Creek Park, but limited to residential permits elsewhere.

<sup>59</sup> "The District of Columbia," Atlas Plus, accessed December 14, 2015, <http://atlasplus.dcgis.dc.gov/>.



## Circulation/Access



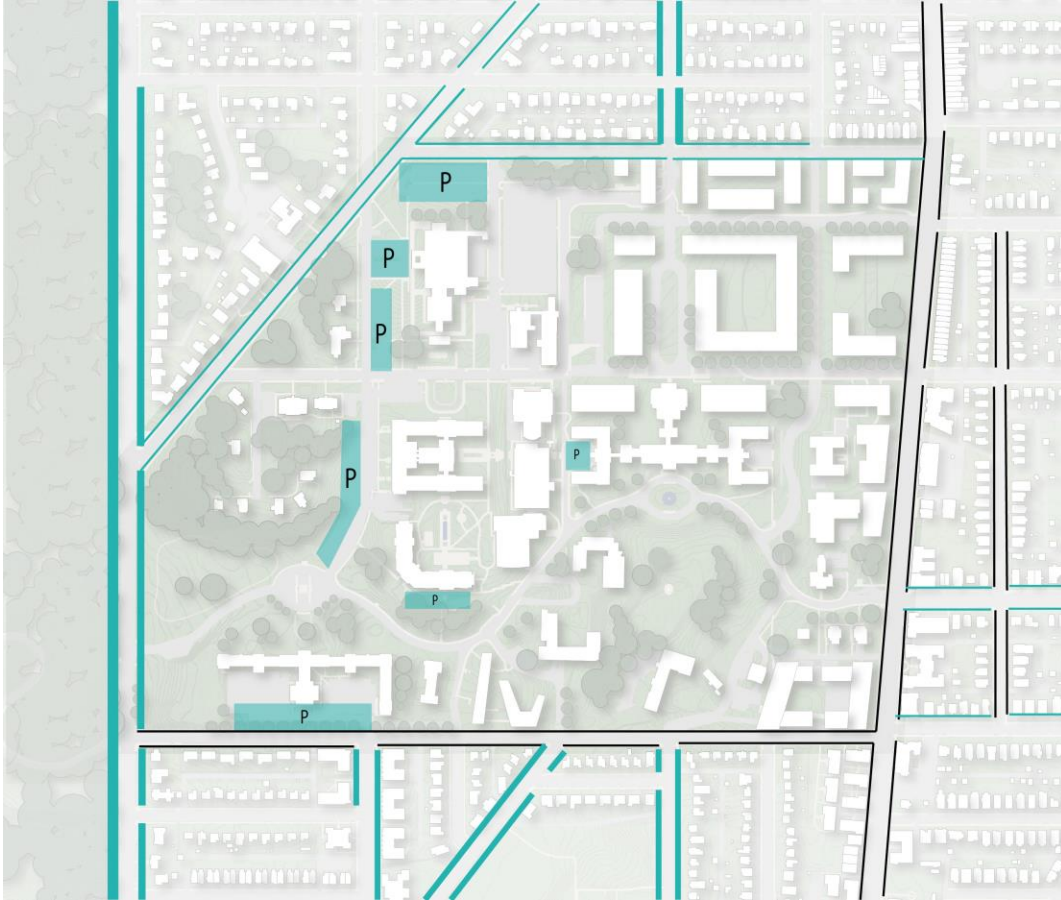
**Figure 33 - Site Access** – Source: Underlay GIS Washington D.C., Image by Author

Historically there was limited access to the site. All of the historical entries were gated and rarely open to the public. The new, proposed plan introduces new entry points and enables a stronger connection to the surrounding community. The site now engages the residences, Georgia Ave, 16<sup>th</sup> Street and Rock Creek Park. The main entrances to the site are from 13<sup>th</sup> Street, where there is a strong axial connection to the central hospital building, from Butternut Street NW, which leads to the Takoma Park Metro Station, and from 16<sup>th</sup> Street and Rock Creek. Each of these access points engage major buildings on the site.



**Figure 34 - Street Hierarchy** – *Source: Underlay GIS Washington D.C., Image by Author*

While the two high capacity streets, Georgia Ave and 16<sup>th</sup> Street run north-south on each side of the street, the main streets within the site run east-west, including the winding, Main Drive NW.



**Figure 35 – Parking** – Source: Underlay GIS Washington D.C., Image by Author

Currently, the main parking on the site is surface parking located in the DOS zone and street parking along the west side and in residential areas. The new plan proposes a number of underground parking garages.



**Figure 36 - Metro Bus Route** – Source: Underlay DC Atlas Plus, Image by Author

There is a number of Metro Bus stops surrounding the site as the Takoma Park Metro Stop on the Red Line of the Metrorail is located  $\frac{3}{4}$  of a mile east. There is potential for new stops on the site, possibly near the building location.

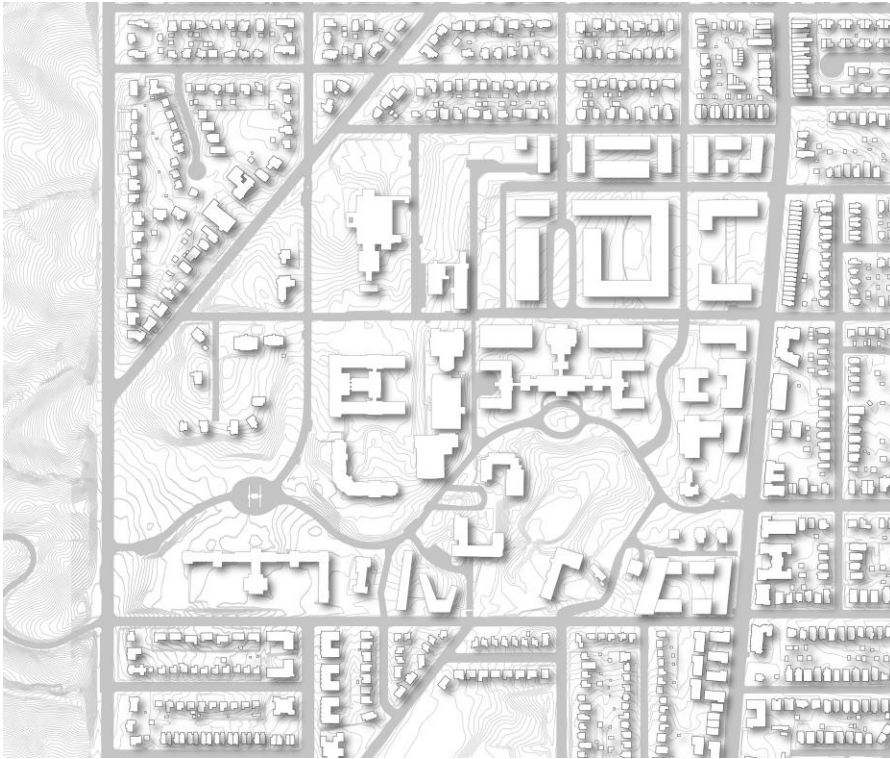
#### Climate/Microclimate

The site experiences all four seasons. The temperature averages 78 degrees in the summer and 35 degrees in the winter. The average rainfall ranges from 2.75 inches to 4.5 inches throughout the year.<sup>60</sup>

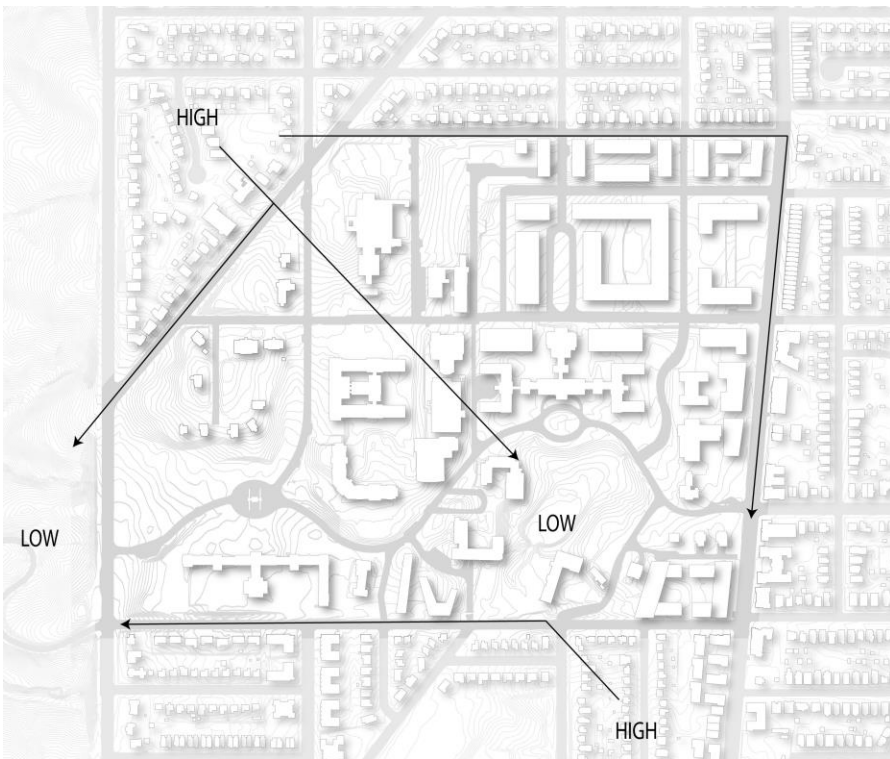
<sup>60</sup> "Takoma Park, Maryland," City-Data.com, last modified 2015, accessed December, 2015, <http://www.city-data.com/city/Takoma-Park-Maryland.html>.



## Contour/Slope



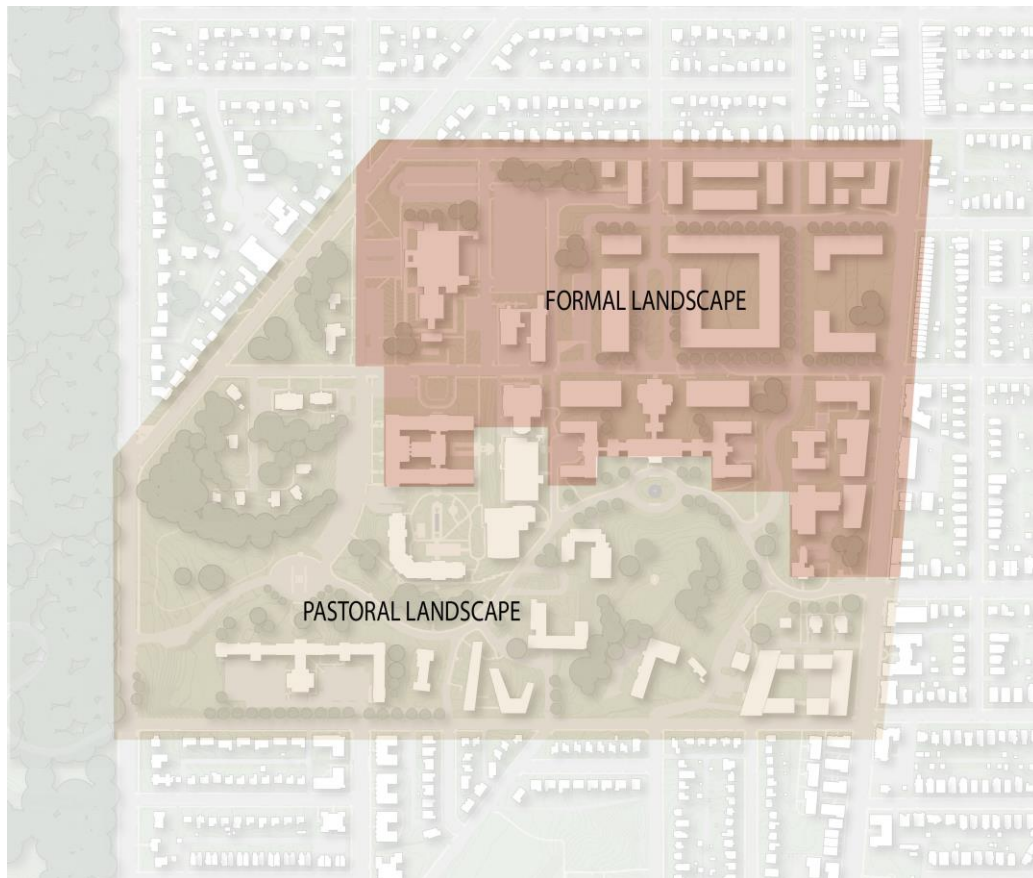
**Figure 37 – Contour** – Source: GIS Washington D.C.



**Figure 38 - Elevation Points** – Source: Underlay GIS Washington D.C., Image by Author

The site has high points in topography to the north-west and south-east so most of the water flows to low points within the pastoral/open section of the site organization. To the west of 16<sup>th</sup> Street the topography dramatically declines towards Rock Creek.

#### Environment/Vegetation



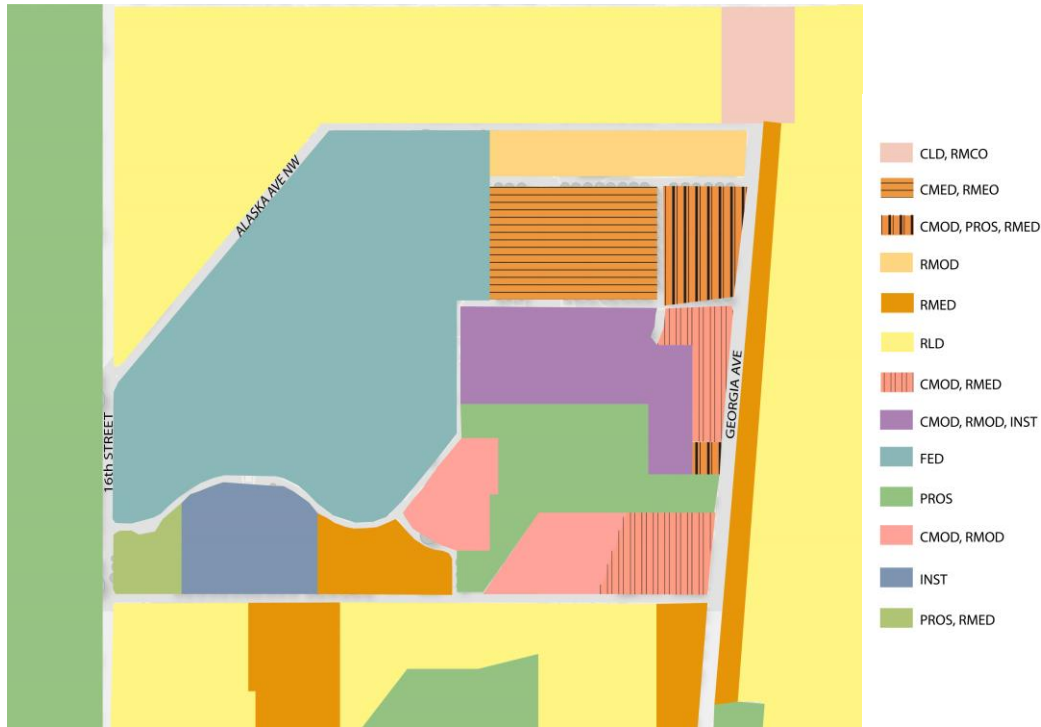
**Figure 39 - Site Characteristics** – Source: Underlay GIS Washington D.C., Image by Author



**Figure 40 - Open Spaces** – Source: *Underlay GIS Washington D.C., Image by Author*

The north part of the site consists of a more formal, urban landscape. This is where the topography is higher and relatively flat and there is less open space. The southern part of the site consists of more irregular building forms and includes large open spaces. The area has a lower elevation which supports a more natural landscape including vegetation and a pond.

## Context/Zoning



**Figure 41 - Land Use** – Source: *Underlay GIS Washington, D.C., Information The Redevelopment of Walter Reed: A Primer*, Walter Reed Local Redevelopment Authority, Image by Author

The site is surrounded largely by Residential, Low Density (RLD) while the site itself has a wide variety of uses. It includes: Commercial, Low Density (CLD); Commercial, Moderate Density (CMOD); Commercial, Medium Density (CMED); Residential, Moderate Density (RMOD); Residential, Medium Density (RMED); Federal (FED); Institutional (INST); and Parks, Recreation, and Open Space (PROS). This variety of land use allows for many amenities around the building site that can be beneficial to the program.



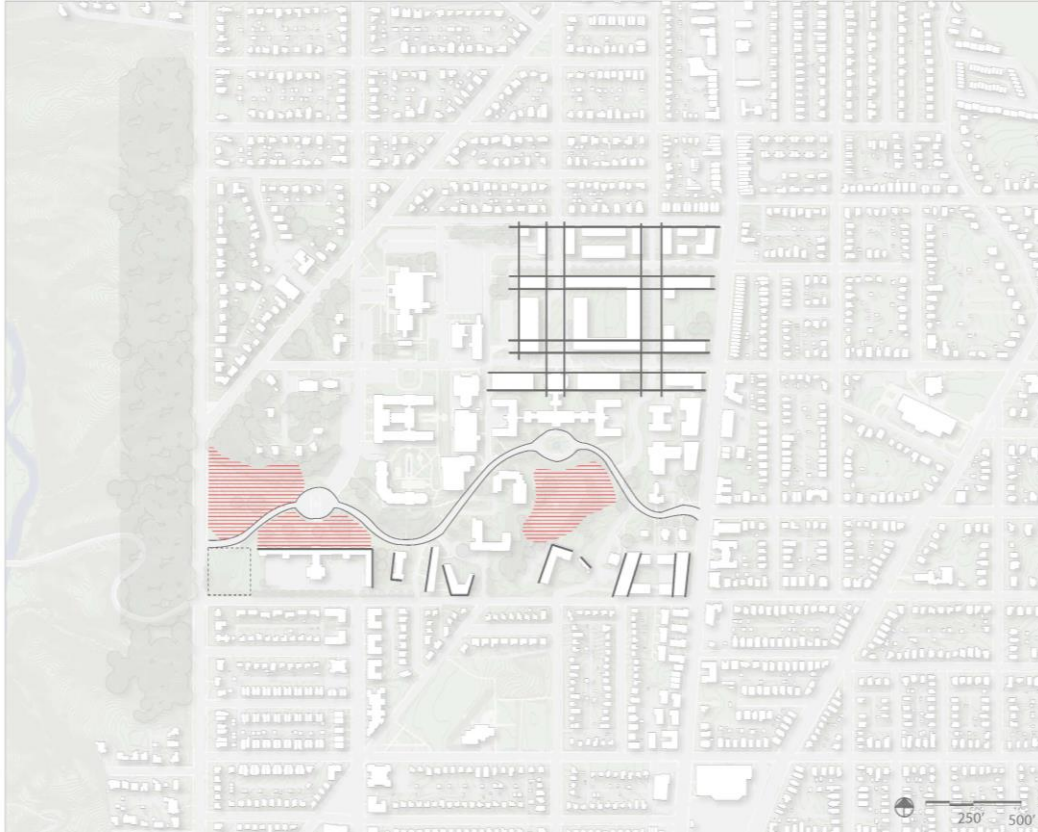


**Figure 42 - Building Use** – Source: GIS Washington, D.C., Walter Reed Army Medical Center, Local Redevelopment Authority, Diagram by Author

The Site has a variety of building uses. The northern and southern parts of the site incorporate residential use which speaks to the existing residential zones. Mixed-use buildings are placed along Georgia Ave to reactivate this edge. The core of the site includes the historic institutional use and new mixed-use creative programs.

### Building Site Selection

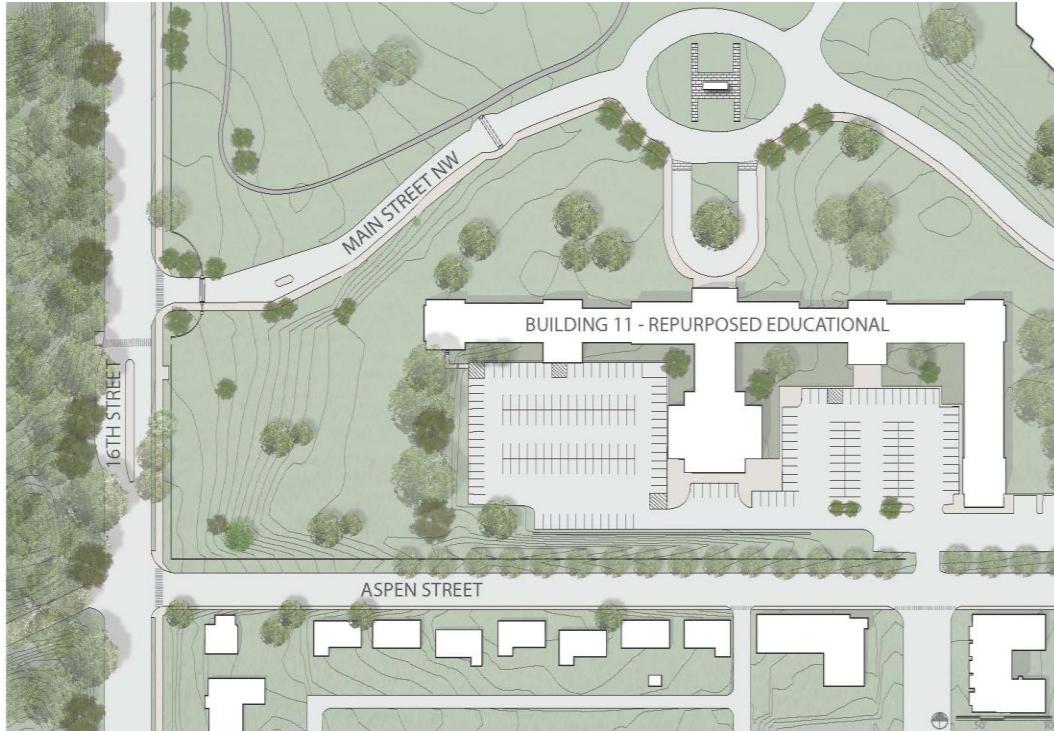
The building site selection was informed by an analysis of the site organization. The site is organized into three main characteristics: the gridded northern extremity, the lyrical, open space in the center of the site, and the dynamic southern edge.



**Figure 43 - Site Organization informing Site Selection** – *Source: Underlay GIS Washington, D.C., Image by Author*

There seems to be a missing link in the dynamic southern edge, which upon closer look, became the site of the prosthetics rehabilitation center. The building site is adjacent to 16<sup>th</sup> Street and Rock Creek Park on the west and Building 11 on the east. Building 11 is one of the original hospital buildings on the site (*see Figure 26*).

It is proposed to be repurposed for educational use and for the means of the thesis will be a school for students studying advancing technologies in the medical field.



**Figure 44 - Existing Building Site** – Source: Underlay GIS Washington D.C., Image by Author

There is a 20 foot topography change from Building 11 to 16<sup>th</sup> Street which allows for empowering views to the tranquil Rock Creek Park. However, Building 11's unfinished façade creates a stark contrast to the greenery and historical brick. This unfinished wing has been hidden and forgotten, a scar on the face of the building. This thesis proposes to rehabilitate this building and unfinished façade by completing the missing wing with the new facility.



**Figure 45 - View from Building 11 to 16th Street and Rock Creek Park** – *Source: Torti Gallas and Partners*



**Figure 46 - Unfinished Wing and Facade of Building 11** – *Source: Torti Gallas and Partners*



**Figure 47 – Building 11’s Missing Wing**– *Source: Torti Gallas and Partners*



**Figure 48 - View of Northern Edge of Site and Main Street NW** – *Source: Torti Gallas and Partners*



**Figure 49 - Building 11 Northern Façade** – *Source: Torti Gallas and Partners*



**Figure 50 - View of Site from corner of 16th Street and Aspen Street** – *Source: Image by Author*



**Figure 51 - View of site topography from Aspen Street** – *Source: Image by Author*

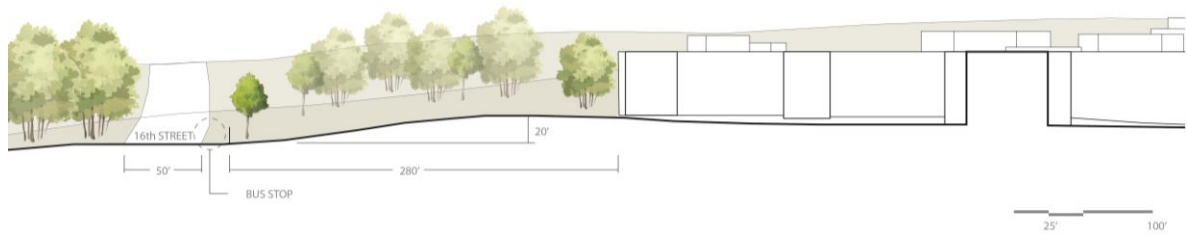


**Figure 52 - Building 11 Southern Facade Eastern Wing** – *Source: Photos by Torti Gallas and Partners, Image by Author*





**Figure 53 - Building 11 Southern Facade Western Wing** – *Source: Photos by Torti Gallas and Partners, Image by Author*



**Figure 54 - Existing Site Section** – *Source: Image by Author*



## Chapter 7: Design

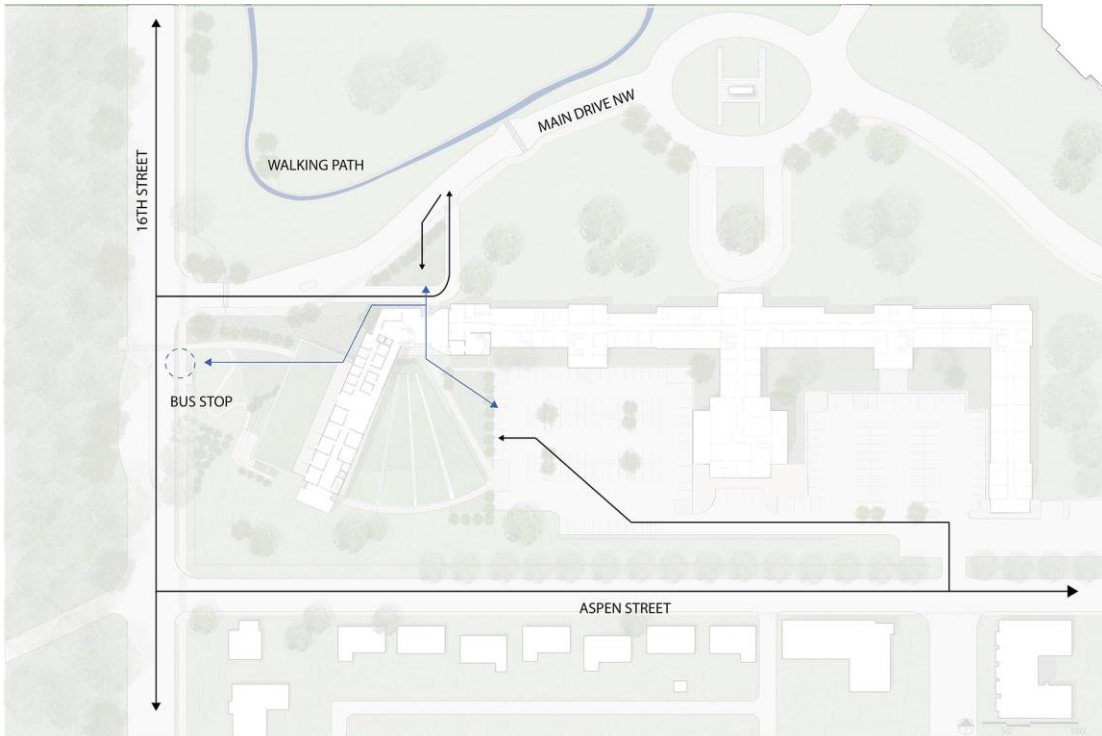
### Conceptual Design Strategies

The design objectives of this thesis include: (1) providing for patients' physical needs in the form of large rehabilitation space and ease of movement through the building; (2) providing for patients' environmental needs by connecting them to the surrounding landscape and creating dynamic spaces within the building; and (3) providing for patients' psychosocial needs by allowing for collaboration, group space and individual space that can empower and inspire them.

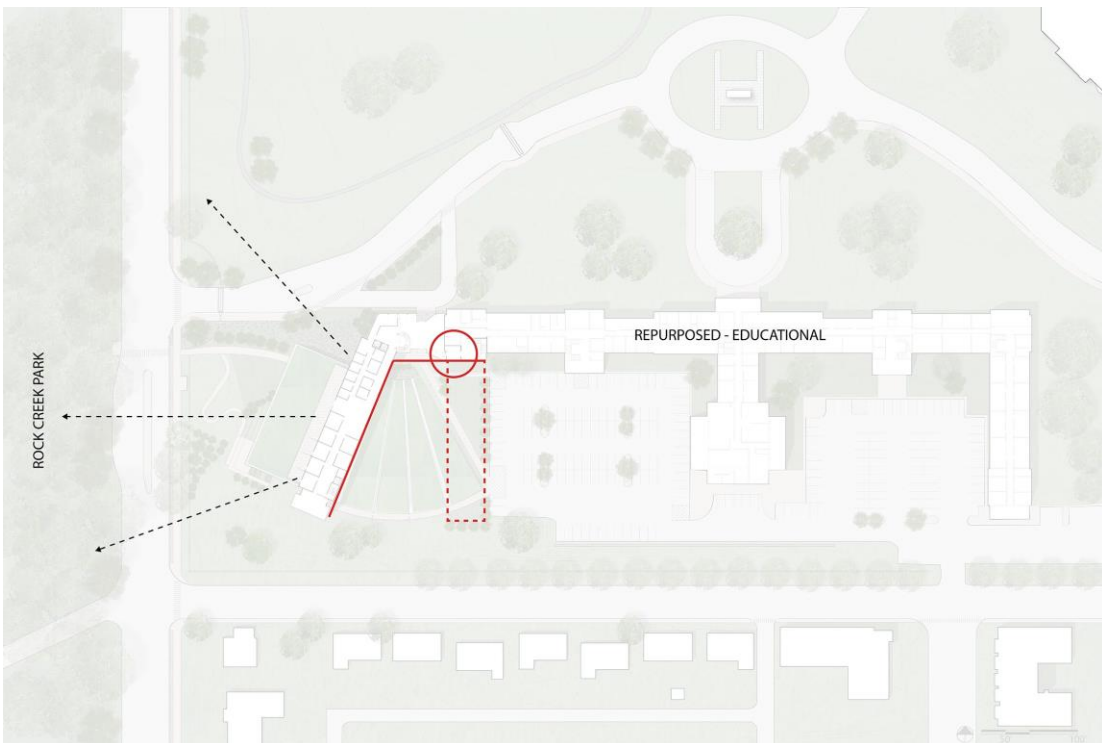
#### Impact of site analysis

The site analysis informed the placement of the building and its relationship with the landscape. Placing the building at the top of the steep topography allowed for empowering views to Rock Creek Park and a closer connection to Building 11.

Accessibility of the building is extremely important. The steep topography of the site posed a challenge for access and wheelchair accessibility. The parking lot to the east of the building provided for an eastern entry to the building. However, the main entry to the north required a grade change to allow for automobile access and a drop off location. This slight change of grade also allowed for ease of pedestrian access to the walking trail and bus stop.



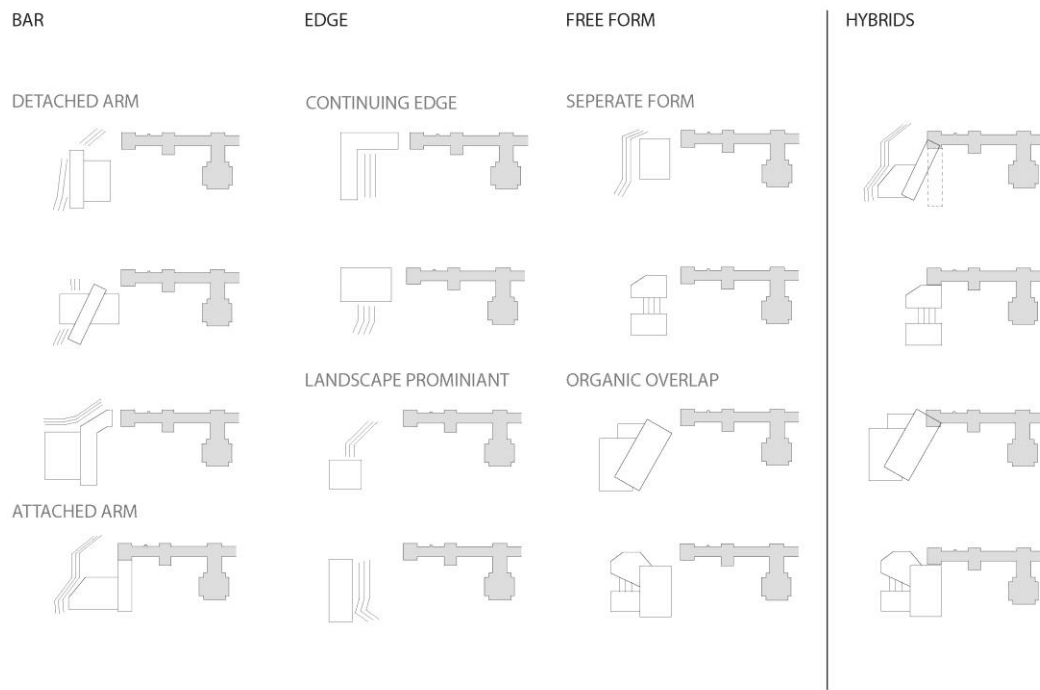
**Figure 55 - Building Site Access** – Source: GIS Washington, D.C., Image by Author



**Figure 56 - Building Site Opportunities** – Source: GIS Washington, D.C., Image by Author

## Impact of program analysis

The program analysis helped inform the configuration of the building. The thesis began with analysis of multiple schematic forms and their relation to the site. This exploration included bar buildings, of which could replicate the missing wing of Building 11, edge buildings, of which created a boundary for the site, and organic free-form buildings which stood out independently of the site context. All of these schemes questioned the building's relationship with the landscape.



**Figure 57 - Schematic Parti Studies** – Source: Image by Author

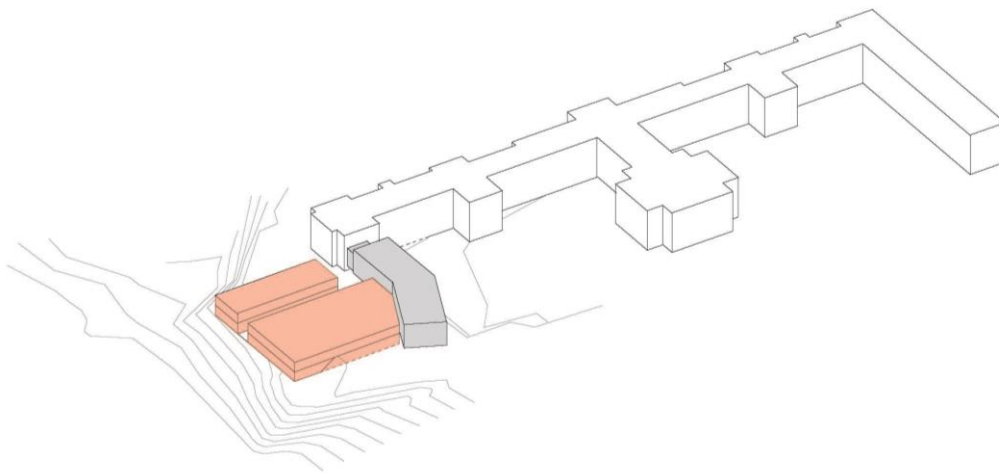
However, in the end, the programmatic requirements of the thesis had a large influence on the form of the building. The rehabilitation and research/manufacturing portions of the building required large, open, flexible space for the patients, therapist and staff. The rest and administrative areas of the building are more functional as

cellular, repetitive spaces. This produced two separate massings that shaped the building: a bar structure and a large, flexible ground floor.

### Parti Analysis

#### Parti 1 – Site and Building Organizational Strategies

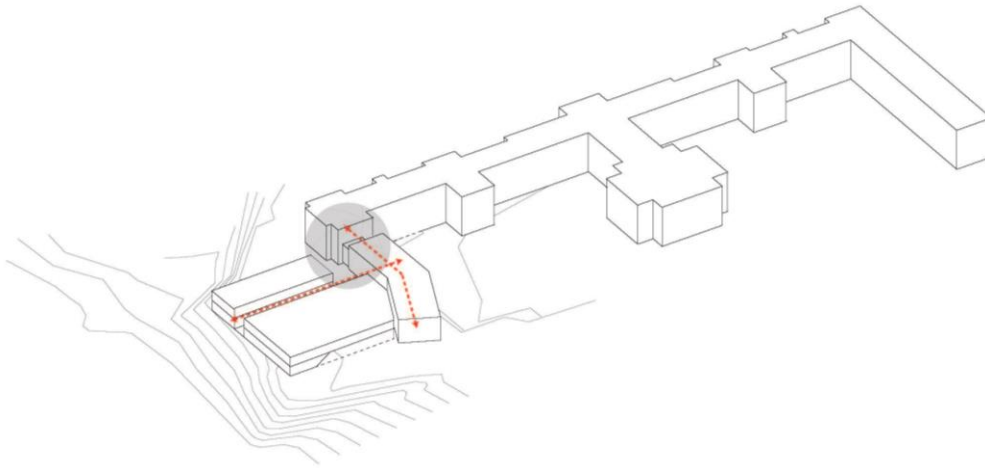
This thesis considered two initial partis. The first parti completes the missing wing of Building 11 to the south and extends the large, flexible space to the west. In this design the connection between Building 11 and the new prosthetics rehabilitation facility happens along the eastern edge of the site facing the parking lot. This connection references the “implanted” connection of prosthetics analyzed in Chapter 2. This creates a more invasive, direct connection to Building 11.



**Figure 58 - Parti 1 Massing** – Source: Image by Author

This parti allows for a main axis and cross axis of circulation and connection to the landscape. However the parti lacks the presence of a “front” to the building. The only entrance is from the back parking lot and the central node of the building

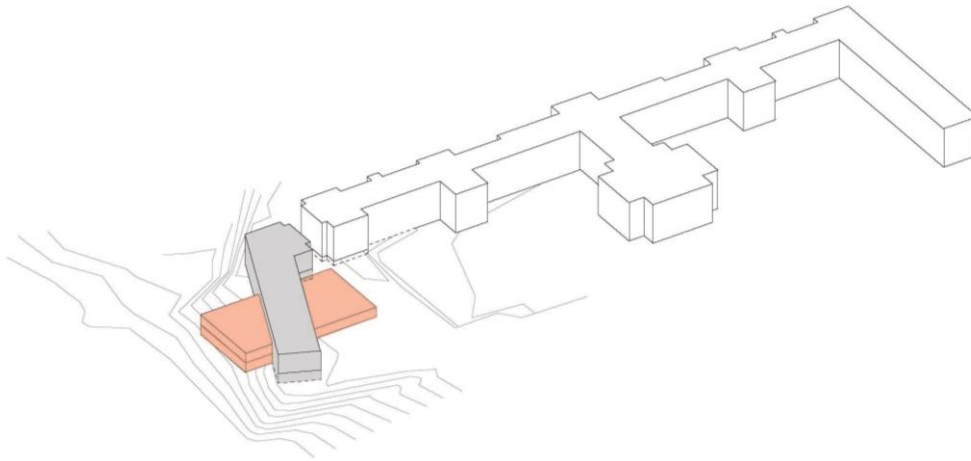
seems to be hidden behind Building 11's unfinished façade. While this parti provides efficient space for the programmatic elements and an axial relationship with Rock Creek Park, a central node and ease of circulation is lacking.



**Figure 59 - Parti 1 Circulation** – Source: Image by Author

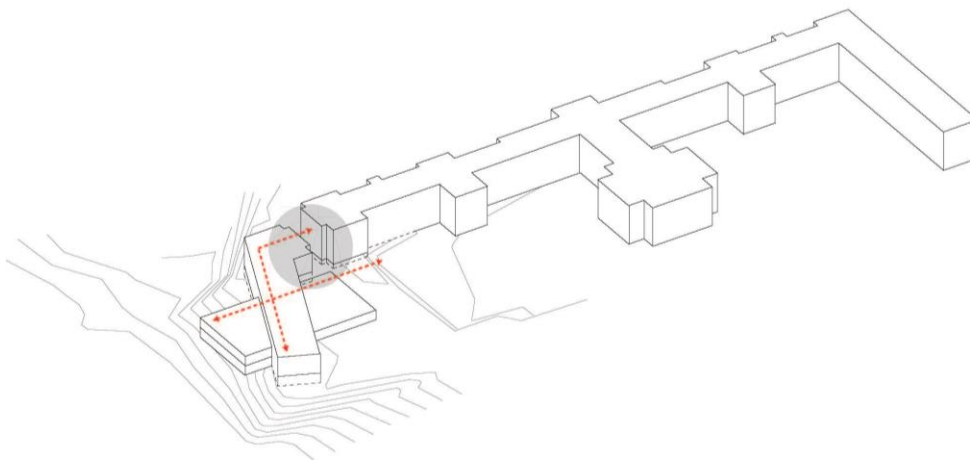
#### Parti 2 – Site and Building Organizational Strategies

The second parti completed the missing wing of Building 11 to southeast with the large, flexible space sliding underneath. In this design the connection between Building 11 and the new facility happens along the northern edge of the site. This parti implements the “socket” connection which creates a larger spatial node for the building and allows for the new facility to wrap around the unfinished end of Building 11.



**Figure 60 - Parti 2 Massing** – Source: Image by Author

This parti produces an entry node for the building. The socket connection is located towards the north east of the site allowing for a back entry from the parking lot and a front entry from Main Street NW on the north of the site. This provides a “front” for the building while also permitting entry from the east. Having two entrances meet at this point verifies its significance for the user and then invites them to continue down the wing of the facility through the rest of the building.



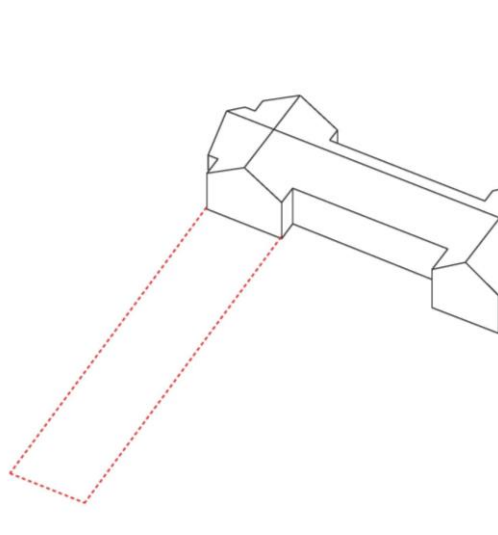
**Figure 61 - Parti 2 Circulation** - Source: Image by Author

### Final Design

The final building design evolved from the second parti.

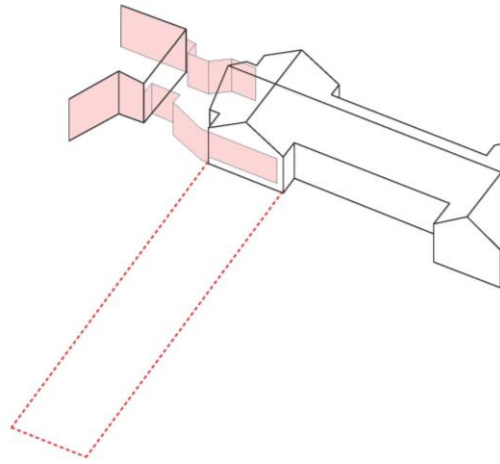
#### Parti Build Up

The parti design began with the unfinished façade of Building 11 and the “ghost” of the missing wing.



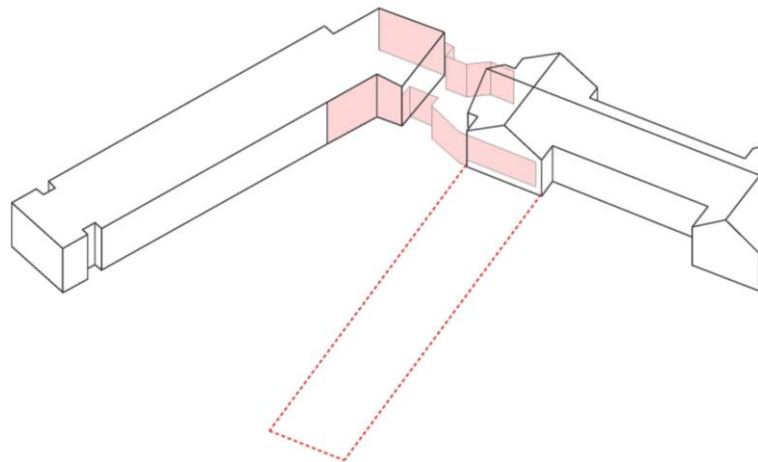
**Figure 62 - Building 11 and "Ghost" Wing** – *Source: Image by Author*

The design implemented the ‘socket’ connection in which the new facility wrapped around the end of Building 11, graphing onto its unfinished façade. This creates residual space within the connection between the old and new building providing a central node for the building.



**Figure 63 - Socket Connection** – *Source: Image by Author*

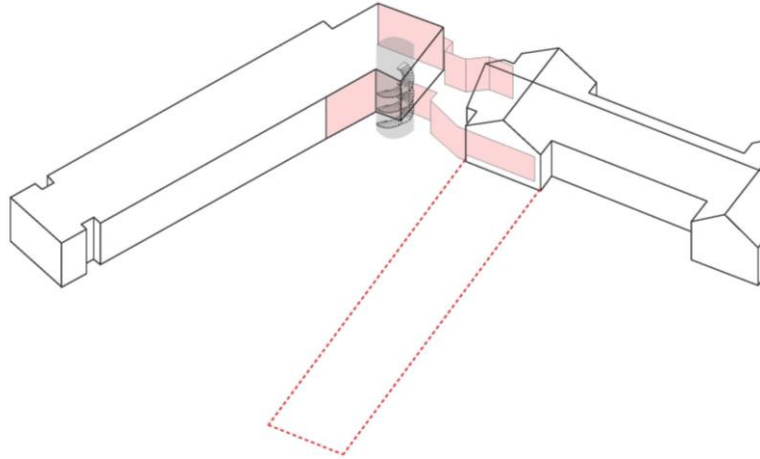
The missing wing of Building 11, or the bar of the schematic parti, was added. As stated, this holds the more cellular programmatic elements of the facility such as the exam rooms, offices and patient rooms.



**Figure 64 - Completing the Missing Wing** – *Source: Image by Author*

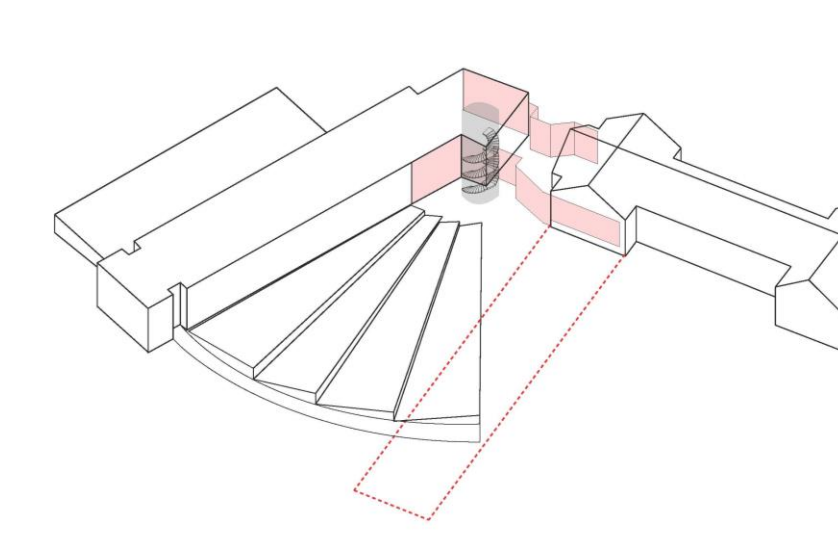


As seen in the analysis of prosthetic connections, a hinge point was added to create a pivot point and node for the building. The design embodied this through the use of circulation in the form of a central staircase.



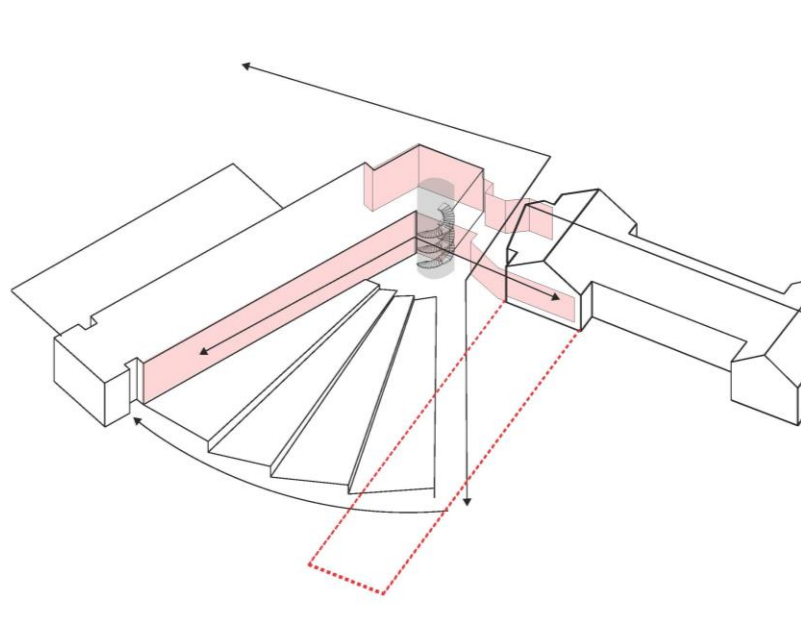
**Figure 65 - Hinge Joint** – Source: Image by Author

This hinge point informed a radial form across the site. This provides a large footprint for the flexible rehabilitation space in the facility.



**Figure 66 - Radial Movement** – Source: Image by Author

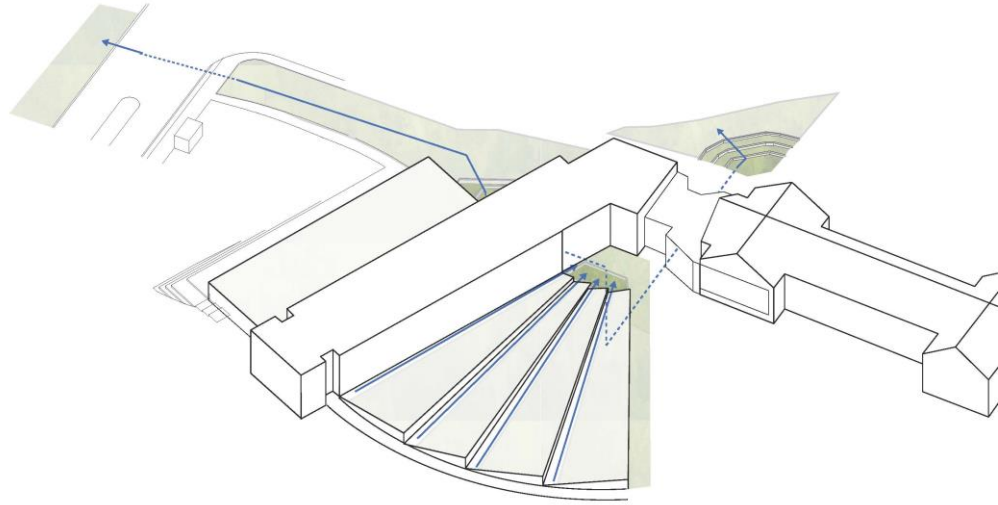
The final parti of the building is reflective of “socket” prosthetic connection. The building node manifested by the socket connection and the hinge component of the stairs create a pivot point for the building of which all aspects revolve around or engage with.



**Figure 67 - Final Building Parti** – Source: Image by Author

#### Site Strategies

This thesis looks at the landscape as a living system and integrates it within the prosthetic design. On the east side of the building, large trusses spanning the rehabilitation space below, slice through the landscape. This creates slanted green roofs which serve to collect, filter and control storm water. The water runs down the green roof and along the trusses and is captured in a water basin near the node of the building. This water is then siphoned under the building into terracing on the north and west of the site. This water then drains through constructed landscape to Rock Creek Park.

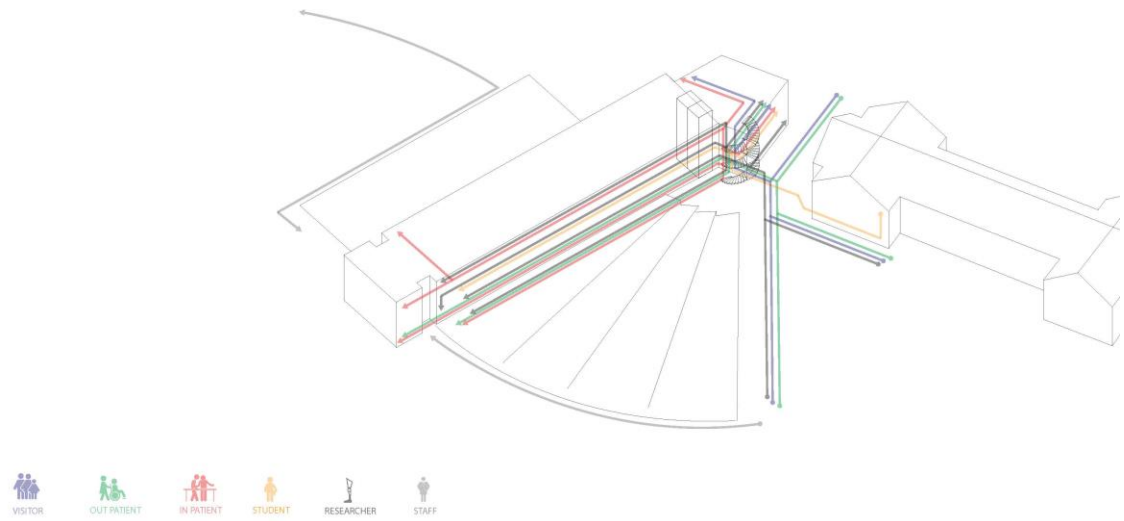


**Figure 68 - Living System, Landscape** – *Source: Image by Author*

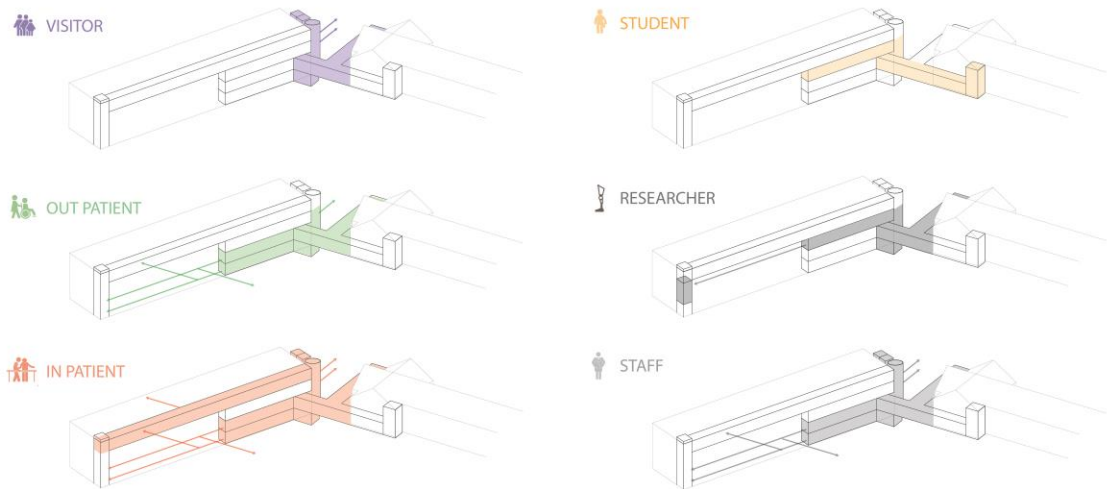
#### Circulation

The circulation of the building reaches out from the hinge staircase and ties the whole building together. The main route of circulation is along the eastern façade in the bar of the building moving from the public entry to the private. This movement on the eastern side of the building allows for rooms of occupation to be placed on the western side of the building. This provides views to Rock Creek Park and a stronger connection between the patient and their environment.

There is a wide variety of occupants in the building and the thesis explores how to provide individual spaces for each of its users, but also allow for spaces of interaction and exchange. The occupants of the facility include: visitors, inpatients, outpatients, students, researchers and staff, each of which engage with the node of the building at some point in their day.



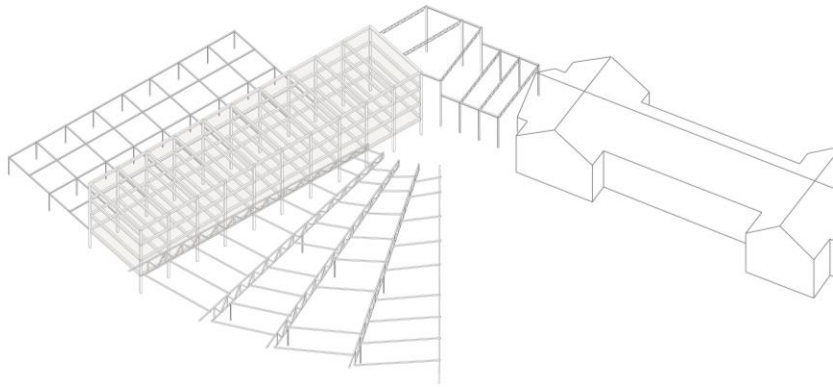
**Figure 69 – Combined Circulation – Source: Image by Author**



**Figure 70 - Individual Circulation – Source: Image by Author**

## Structure

The structure of the building is also divided into two parts. The bar segment of the building is concrete column and beam framing. This sturdy, older material reflects the other historical buildings on the site and also grounds the patient and insures stability. The connection piece and radial rehabilitation space of the building are steel construction. This allows for visible connection joints and enables a sense of strength and resilience for the patients. Long spanning trusses and glass facades can engage and inspire the occupants. Lastly, the class of old and new materials reinstates the premises of old and new joining together both physically and metaphorically.

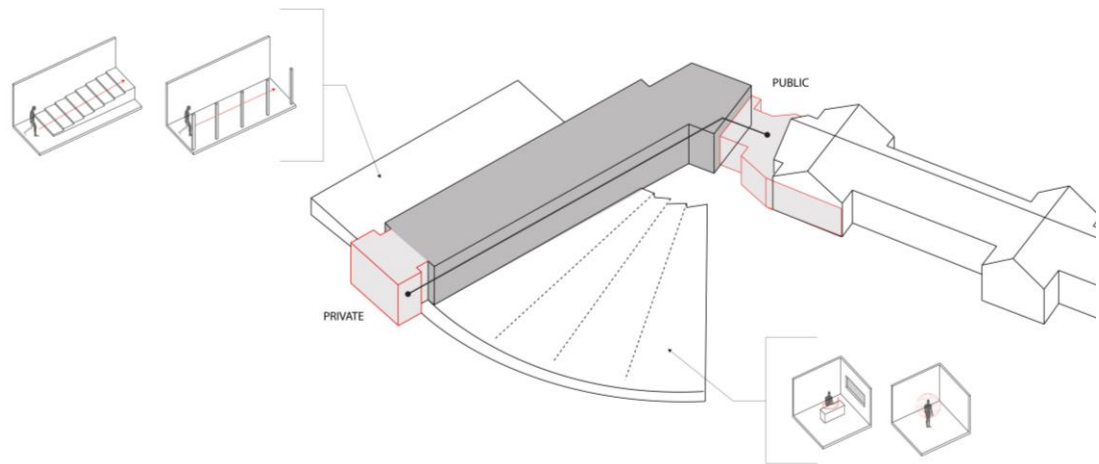


**Figure 71 – Structure** – *Source: Image by Author*

## Spatial Typologies

The informed spatial typologies from the body analysis in Chapter 2 are incorporated in the design of the building. Long, linear space is provided for lower

limb rehabilitation and gait studies. This space reaches out towards Rock Creek Park empowering its occupants. Smaller, centralized spaces are implemented in the western half of the building for upper limb rehabilitation and occupational therapy.



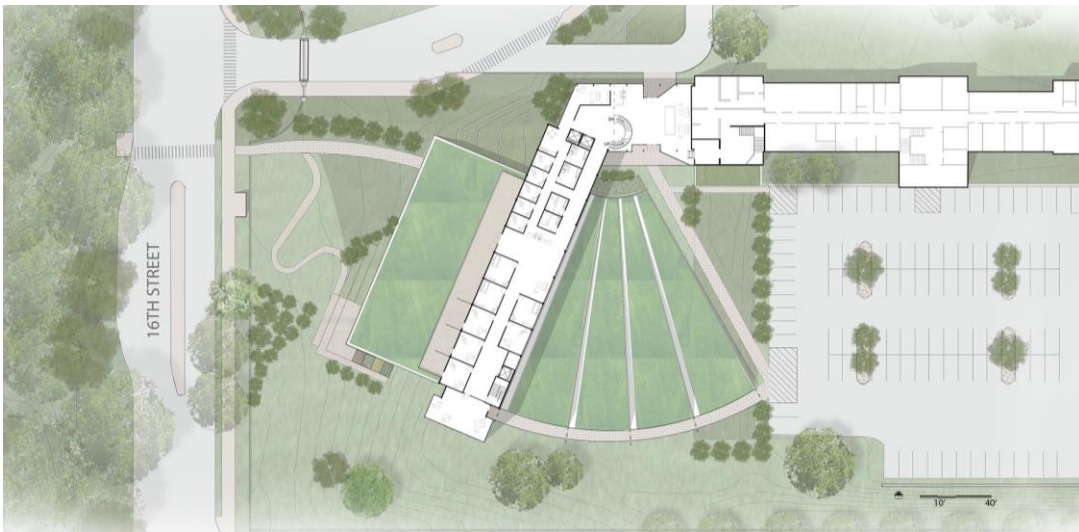
**Figure 72 - Spatial Typologies** – *Source: Image by Author*



**Figure 73 - Southern Facade Aerial** – *Source: Image by Author*

## Level 1

Level 1 is the main floor of the building. One can enter either from Main Street NW via the northern entrance of the building or from the parking through the southern entrance. The northern entrance to the building is largely for drop-offs. Patients can be driven directly to the front door, dropped off, and enter the lobby of the building. The southern entrance is used by patients and staff alike.



**Figure 74 - Level 1** – Source: Image by Author

The southern entrance is more experiential. An individual moves from the parking lot, through the “ghost” of the missing wing, past the large trusses and views to the rehabilitation floor, towards the hinge staircase, and into the connection node of the building. An allee of trees was designed to reference the placement of the unfinished wing of which patients can walk through and reflect on what is missing. They can see the unfinished façade with a light perforated metal covering. However, they can also see hope and achievement in the rehabilitation space and a hint of movement in the landscape radiating from a dynamic hinge within an inspiring connection joint.

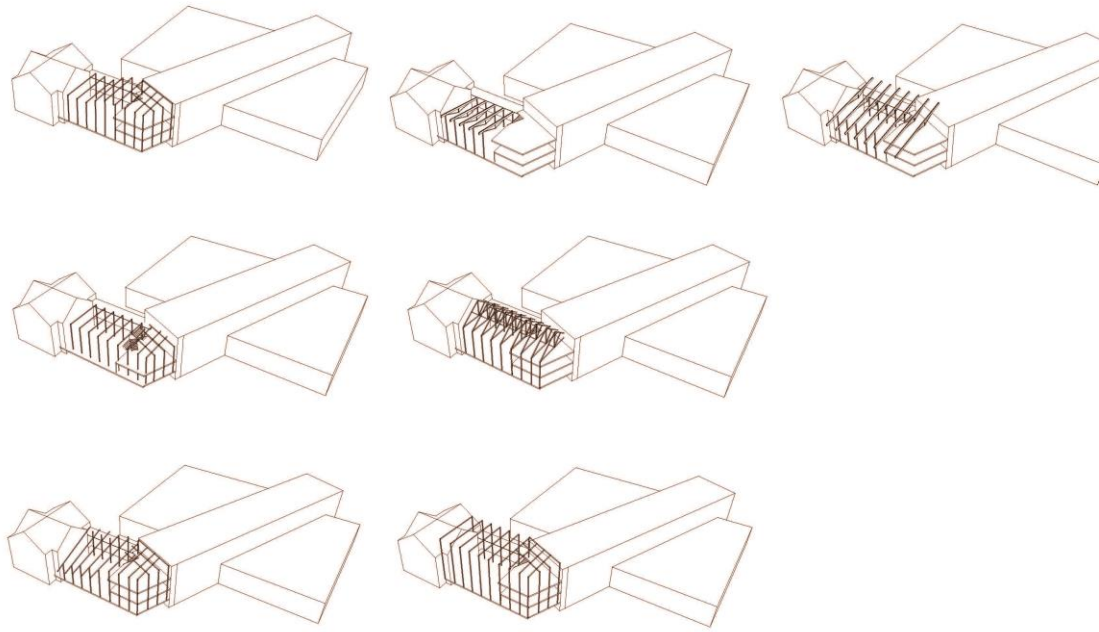




**Figure 75 - Phantom Threshold, Southern Entrance** – *Source: Image by Author*

The connection node of the building serves as the lobby and waiting room for the facility. This part of the building went through a structural and spatial design analysis. The thesis aims for this space to be empowering and inspiring for the patients and show a clash and movement from old to new. The western brick façade of Building 11 was kept intact and the steel structure of the lobby and new building stood independently adjacent with a perforated metal wrapping the two exteriorly. A new opening was added to the façade of Building 11 to allow an entrance for students into the building.





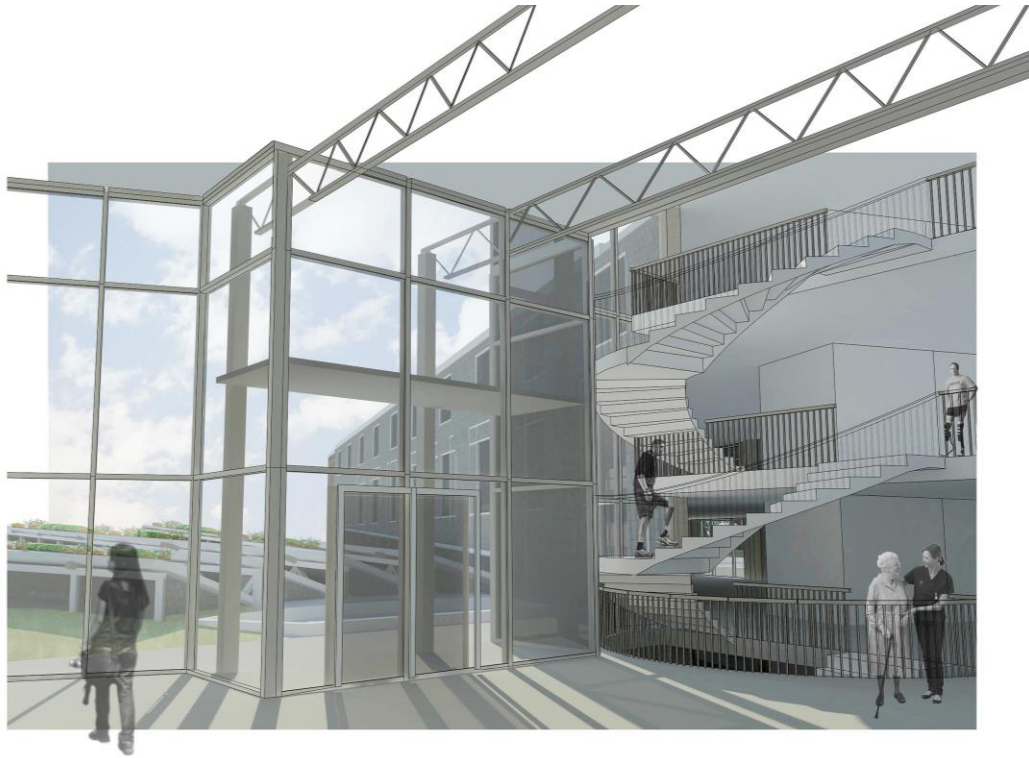
**Figure 76 - Lobby Structure and Form Studies** – *Source: Image by Author*



**Figure 77 - Hinge Connection, Section Perspective** - *Source: Image by Author*

The lobby space is double height with the large circular stair at its focal point and contains the reception desk, waiting area and views to the café and visitor lounge

above. The space has floor to ceiling glazing allowing views to the surrounding environment.



**Figure 78 - Building Node, Lobby** – Source: Image by Author

Continuing through the building, the exam, consultation rooms and psychotherapy rooms align the western side in the bar of the building. This allows views to Rock Creek Park and access onto the rooftop garden from the therapy rooms. This floor also contains specialized exam rooms, such as the electromyography analysis. At the southern end of this floor is the day room. This can be used as a lounge for the patients, a group therapy space, or set up for educational sessions. This room has floor to ceiling glazing and cantilevers past the radial

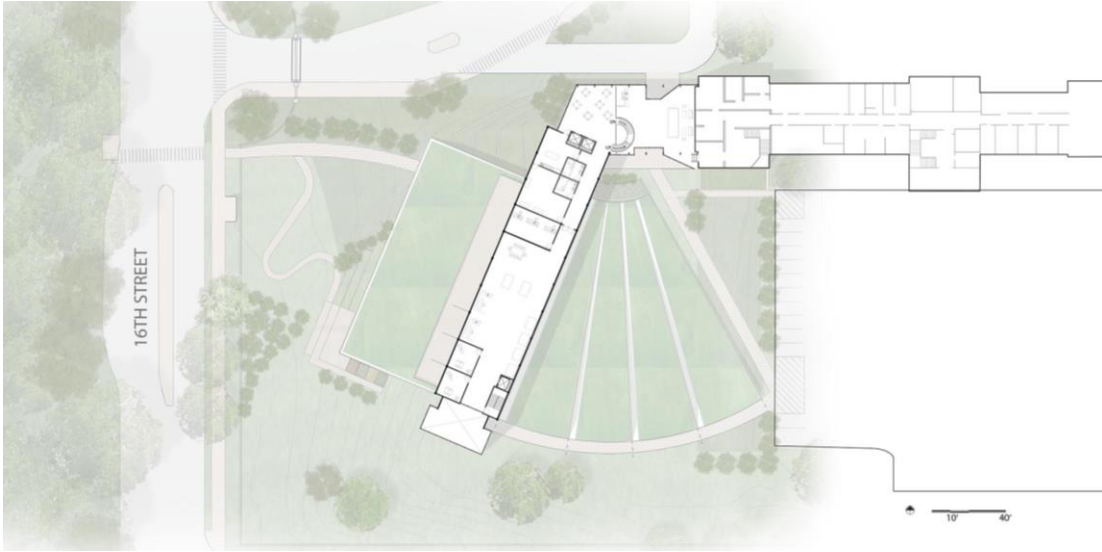
rehabilitation floor below emphasizing an outward reach and expansive views to Rock Creek Park.



**Figure 79 - View of Southern End of Building and 16th Street** – *Source: Image by Author*

## Level 2

Level 2 contains the research aspects of the program. This floor would not only be used by patients and therapist, but also researchers and students. The north side of Level 2, adjacent to the hinge connection, is more public in function, while the southern side is solely for researcher and patient use.

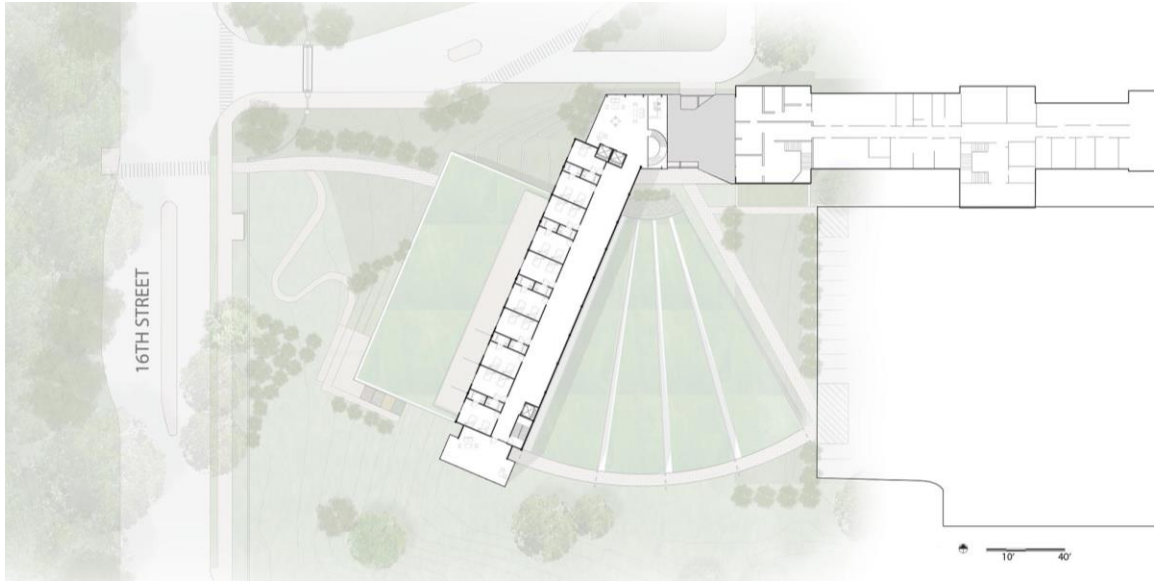


**Figure 80 - Level 2** – Source: *Image by Author*

After ascending to Level 2, one is greeted by the dining area. This space is for patients, visitors and students and overlooks the lobby space below. Moving further down the arm of the building one comes to the Activities of Daily Living room. Here patients relearn everyday activities, such as cooking, cleaning and laundry. This space was placed directly adjacent to the kitchen to allow for patients to work on skills in the kitchen as well. Continuing down the hall, one enters the research portion of the building. This includes offices, collaboration space, virtual reality simulators, 3D printers and machines for the manufacturing of prosthetics. There is also rooms for the fitting and adjustment of patient's prosthetics as this is very important in the rehabilitation process.

### Level 3

The third level of the building is dedicated to rest.



**Figure 81 - Level 3** - Source: Image by Author

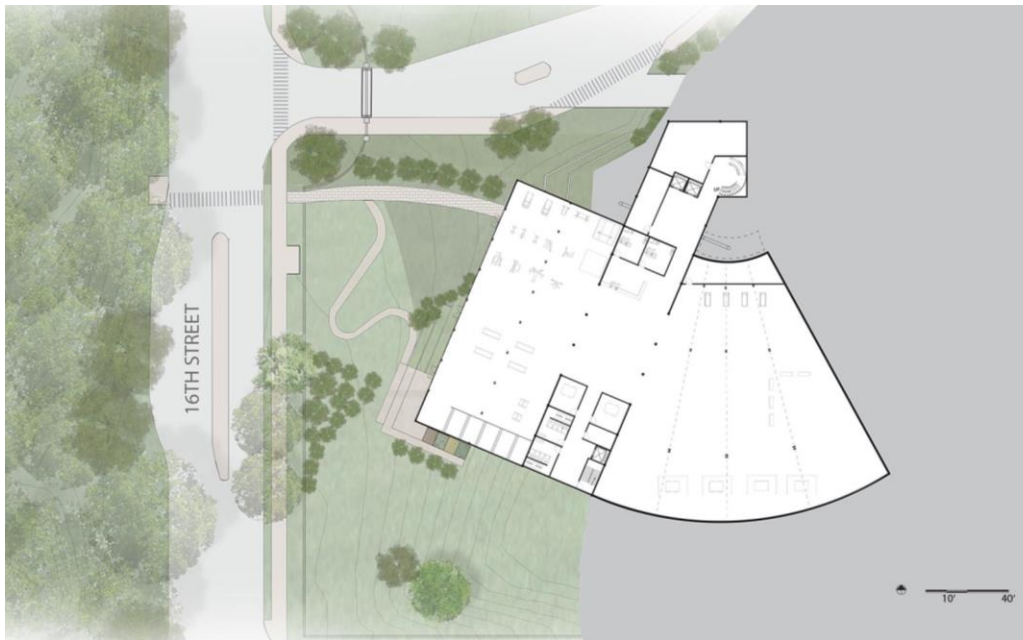
At the north end of the arm is the patient lounge. This space is a day room for patients and their visitors which aims to foster social support and encouragement. Running along the west side of Level 3 are the patient rooms. There are ten patient rooms with two beds in each. This allows for either single occupant use or double occupant use in which two patients can room together or a family member can stay with the patient. Each patient has their own bathroom fit for ADA regulations. The placement of the rooms provides empowering individual views to Rock Creek Park. At the southern end of Level 3 is the private patient day room. This space is for individual reflection and peace.

#### Level 0

Level 0 is the main rehabilitation floor of the building. This floor provides space for physical therapy, including gait rehab and occupational therapy, a workout



gym, additional offices, and support spaces such as locker rooms, storage and mechanical.



**Figure 82 - Level 0** – Source: Image by Author

The bar form in Level 0 also contains the more cellular programmatic functions. The north side houses additional staff offices while the south side contains private therapy rooms and locker rooms. The western half of the flexible rehabilitation space is dedicated to gait therapy and gym space. The gait rehab area looks out onto Rock Creek Park and has a direct connection to the landscape. Patients can walk on the outside terracing to rest, or to continuing practicing on a variety of outdoor terrain. The eastern half of this floor holds a variety of activities. This space is for occupational therapy, therapy equipment and massage tables, and semi-private rehabilitation space. Here patients can workout below the large spanning trusses that are cutting through the landscape above and providing clearstories for lighting and occupant views.



**Figure 83 - Flexible Rehabilitation Space** – *Source: Image by Author*

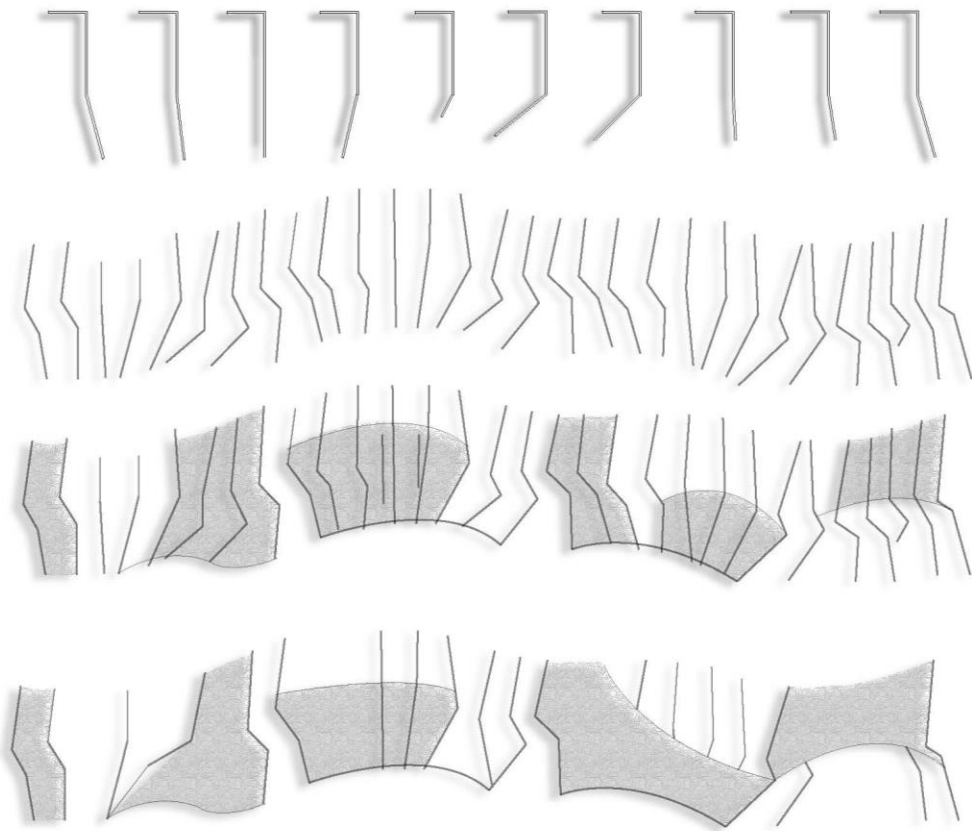
#### Elevation Designs

One of the main exterior architectural elements of this thesis is the western façade. While the eastern façade is more subdued with the landscape taking foreground, the western elevation demands a presence on 16<sup>th</sup> Street. The aim of this façade is to emphasize the movement within the building and liberation of its occupations.

The elevation has large windows to allow for ample lighting and empowering views to Rock Creek Park. Fins are placed in dynamic repetition along the façade mimicking movement and providing sun shading for the interior spaces behind. Over these fins stretches a perforated metal that emphasizes movement, provides extra shading, and enables intriguing views from within.



**Figure 84 - West Elevation, 16th Street Façade** – *Source: Image by Author*



**Figure 85 - 16th Street Facade Studies** – *Source: Image by Author*



The elevation also provides an exciting experience for passer byers on 16<sup>th</sup> Street. While the dynamic façade implies movement and promotes what is occurring within the building, it also changes seasonally, animating the building. Greenery grows over the perforated metal, adding not only to the solar shading, but to the living system surrounding the building as a whole. This greenery constantly changes throughout the seasons, creating a new skin for the building each day.

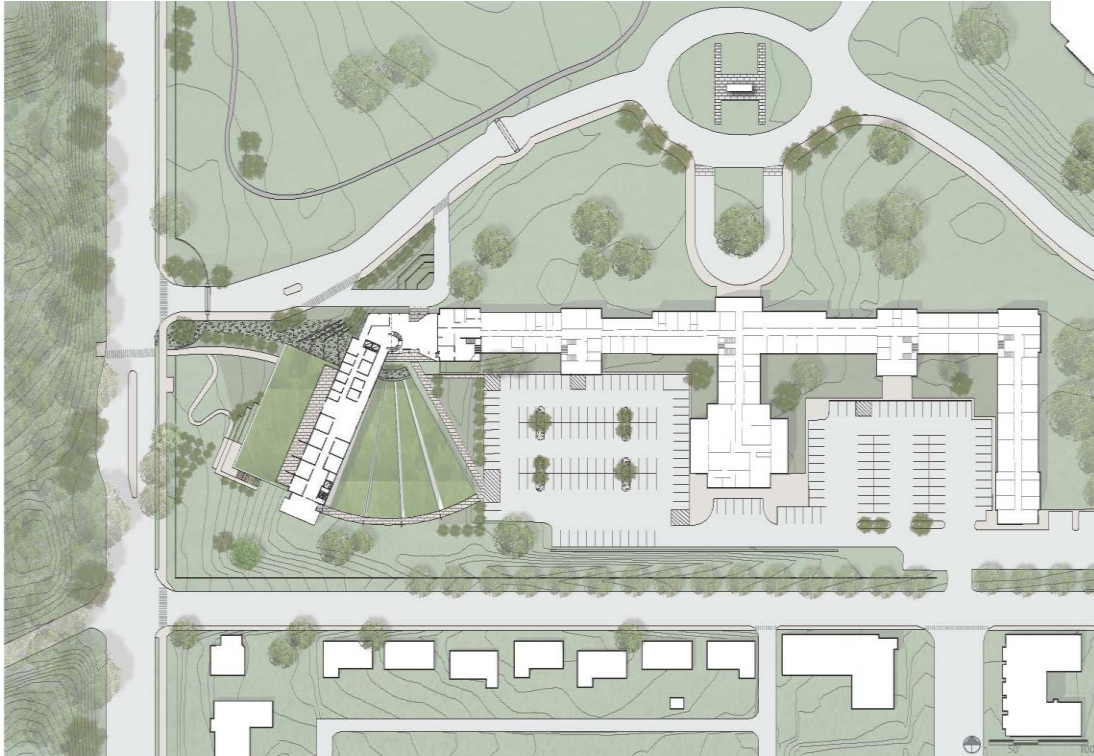


**Figure 86 - 16th Street Dynamic Facade Study** – *Source: Image by Author*

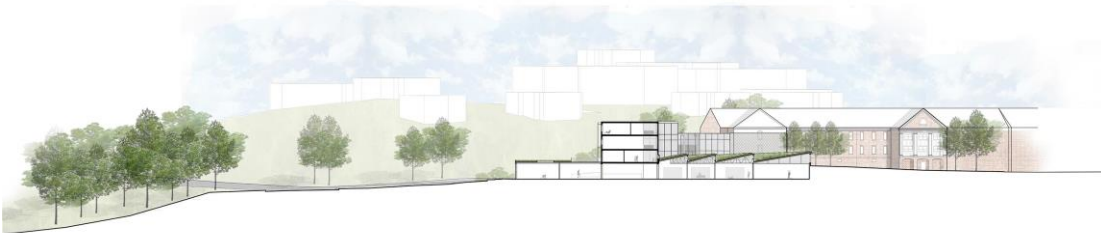
#### Additional Building Drawings



**Figure 87 - Programmatic Section Perspective** – *Source: Image by Author*



**Figure 88 - Site Plan with Level 1** – Source: Underlay Washington D.C. GIS, Image by Author

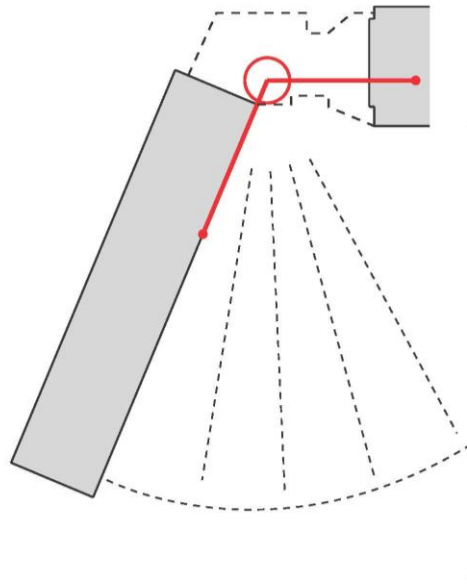


**Figure 89 - Section Cut East West, Southern Façade** – Source: Image by Author

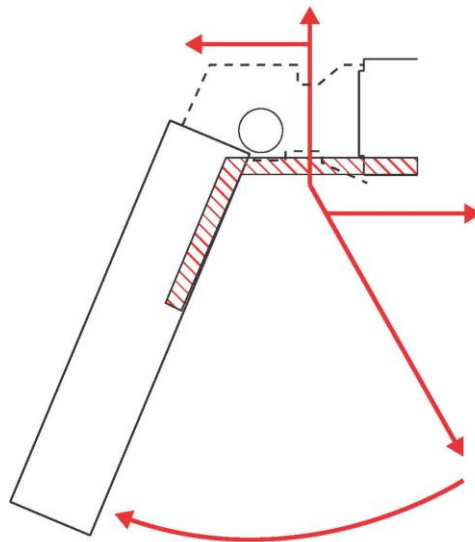


**Figure 90 - Section Cut North South, Eastern Façade** – Source: Image by Author

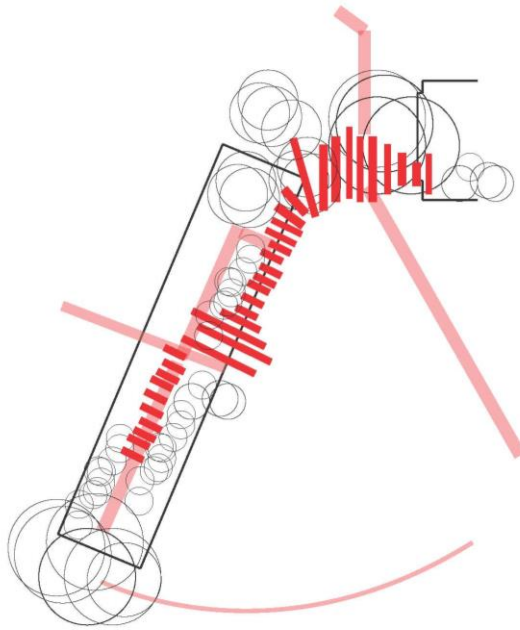
## Additional Building Diagrams



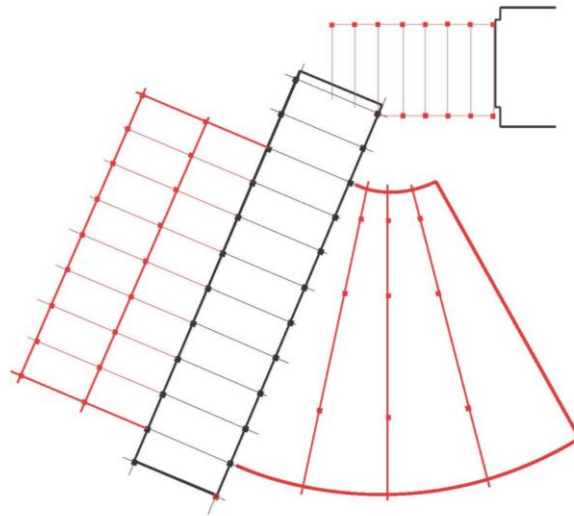
**Figure 91 – Parti** – *Source: Image by Author*



**Figure 92 – Access** – *Source: Image by Author*



**Figure 93 – Flows** – *Source: Image by Author*



**Figure 94 – Structure** – *Source: Image by Author*

## Chapter 8: Conclusion

### Thesis Aggregation

This thesis was an exploration of the relationship between prosthetics and architecture in both a metaphorical and literal sense. It questioned how this relationship could inform the interaction between building and body and how the building could enable connection, movement and empowerment within an individual.

The ‘prostheses’ in architecture are constantly evolving to enable equivalence for their users. Enabling equivalence enables empowerment which is extremely important in healthcare and rehabilitative design. As healthcare design evolves, it must form itself to its users and their wellbeing. The architecture should provide for the needs of the disabled, rehabilitate their physical and mental self, and enhance their quality of life.

An analysis of prosthetic devices and an understanding of the language of the word provide some answers for this thesis’s questions. One can pull from this knowledge to inform spatial typologies and architectural design.



**Figure 95 - Northern Facade Aerial** – Source: *Image by Author*

### *Moving Forward*

Moving forward this thesis will work to amplify its connection to prosthetics in a more literal sense. The building can break through its reserved exterior and question its prosthetic resemblance.

The dynamic movement of the building can be pushed to a more literal sense and building/occupant engagement can be promoted. Implementation of kinetic facades and analysis of how the users interact with and manipulate the building can inform a more intriguing design.

## Glossary

*\*Note: All definitions are obtained from the online Merriam-Webster Dictionary*

### Electromyography (*n*)

: an instrument that converts the electrical activity with functioning skeletal muscle into a visual record or into sound and is used to diagnose neuromuscular disorders and in biofeedback training

### Myoelectric (*adj*)

: of, relating to, or utilizing electricity generated by muscle  
*ex. Myoelectric prosthetics*

### Occupational therapy (*n*)

: treatment that helps people who have physical or mental problems learn to do the activities of daily life

### Prosthesis (*n*)

: an artificial device that replaces a missing or injured part of the body  
*plural: Prostheses*

### Prosthetic (*adj*)

: of, relating to, or being a prosthesis

### Psychotherapy (*n*)

: treatment of mental or emotional illness by talking about problems rather than by using medicine or drugs

### Vocational therapy (*n*)

[therapy] relating to the special skills, training, etc. that you need for a particular job or occupation

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